



WIND MICROCLIMATE ASSESSMENT REPORT

The Oracle, Reading

23 February 2024

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1 INTRODUCTION

This report outlines the results of a wind microclimate analysis for the proposed development known as The Oracle in Reading, UK.

1.1 SUMMARY

Wind microclimate conditions for the proposed development known as The Oracle, Reading were assessed using high resolution CFD.

All ground level wind comfort conditions are expected to be suitable, including thoroughfares, on and off-site building entrances, existing seating areas and proposed seating areas.

All wind comfort conditions for the balconies and level 2 terraces on both Yield Hall Place 1 and Yield Hall Place 2 will be suitable for the intended use.

The inclusion of the proposed development reduces the extent and severity of a region of S15 (distress) exceedance to the west of the Riverside Car Park building, but introduces a localised region of S15 (distress) exceedance to the east of the Riverside Car Park building. As the region of the pre-existing S15 exceedance to the west is a relatively populated area, and the region of the introduced S15 exceedance to the east is a back of house area, the overall impact of the proposed development on the wind safety risk in the local area can be viewed as between net even to net beneficial.

As local future schemes come forward, the introduced S15 (distress) exceedance to the east of the car park is eradicated, and there are no wind safety risks associated with the proposed development.

The level 14 terrace for Yield Hall Place 2 would require either solid balustrades at the north west and south west perimeters, or a marginal reduction in size from these edges, to ensure that there is no safety risk to terrace users.

The north western level 19 terrace for Yield Hall Place 1 would require a solid balustrade around the perimeter in order to have suitable conditions for sitting out in summer.

1.2 GUIDANCE

The assessment was performed using the London Docklands Development Corporation (LDDC) variant of the Lawson Comfort Criteria. The Lawson Criteria are well-established in the UK for quantifying wind conditions in relation to build developments and, although not a UK 'standard', the criteria are recognised by local authorities as a suitable benchmark for wind assessments.

National Planning Policy Framework

The National Planning Policy Framework (NPPF) was revised in December 2023 by the Department of Communities and Local Government (DCLG). The relevant paragraphs are as follows:

Paragraph 135 of the National Planning Policy Framework states that:

"Planning policies and decisions should ensure that developments:[...]create places that are safe, inclusive and accessible and which promote health and well-being, with a high standard of amenity for existing and future users; and where crime and disorder, and the fear of crime, do not undermine the quality of life or community cohesion and resilience."

There is no specific planning policy guidance dealing with microclimate in terms of pedestrian comfort set out in the revised NPPF

Planning Practice Guidance

The Planning Practice Guidance (2021) identifies the potential for tall and large buildings to affect wind microclimate. The National Design Guide (2021) states in Paragraph 71 that:

"Proposals for tall buildings (and other buildings with a significantly larger scale or bulk than their surroundings) require special consideration. This includes their [...] environmental impacts, such as [...] wind. These need to be resolved satisfactorily"

1.3 DESCRIPTION OF DEVELOPMENT

Planning permission is sought for the repurposing and redevelopment of sites at the eastern end of the Oracle to provide a mixed use development comprising residential and town centres uses. The proposals focus around two main sites:

- Former Debenhams department store at the eastern end of the Oracle shopping centre building and northern side of the River Kennet, to be known as Yield Hall Place 1; and
- Vue cinema building on the southern side of the River Kennet and to the east of the Oracle Riverside multi storey car park, to be known as Yield Hall Place 2.

Two detailed planning applications are submitted; one application for Yield Hall Place 1 and one application for Yield Hall Place 2. These applications will be submitted concurrently to Reading Borough Council and expected to be considered and determined in this way by the local planning authority. This report is submitted in respect of both applications and assesses the proposals as a single scheme for the purpose of the technical assessment undertaken. An illustrative plan is submitted with both planning application which identifies the full extent of the proposed developments, and the schemes assessed for the purposes of this report.

Where matters only pertain to one of the planning application sites, these are specifically identified within the report.

Alongside the development proposals on the two sites identified above, a suite of public realm enhancements are proposed within the vicinity of The Oracle, including:

- Junction with London Street and Inner Distributor Road
- Yield Hall Place from junction of London Street to Minister Street
- Oracle Riverside

2 METHOD

To identify the likely effect of the proposed development on the pedestrian level wind environment, a 3D CFD model of the development and surrounding site was created. This section describes the methodology for the creation of this model and the inputs used.

2.1 ASSESSMENT METHODOLOGY

The assessment was performed using GIA's high-resolution Computational Fluid Dynamics (CFD) modelling.

CFD is a digital modelling technique, which simulates the effect of wind for the built environment. The air is divided into hundreds of millions of "cells", within which the equations of motion are solved. GIA uses cloud computing from Amazon Web Services (AWS) to run the simulations, to ensure vast scalability and appropriate resource availability for any project.

A full description of the test methodology is included in Appendix 01.

2.2 ESTABLISHING MICROCLIMATE CONDITIONS

Microclimate conditions were established using a high resolution CFD model, extending 400m radius from the Site.

A model of the Development was included within the CFD model and tested to determine the conditions at and around the Site. The model used is shown in Figure 1, Figure 2 and Figure 3.

The proposed development consists of two blocks, Yield Hall Place 1 and Yield Hall Place 2, named as shown in Figure 1.

The model was run at full scale from 18 wind angles, spaced using 10° or 30° increments such that no sector contributes more than 10% of the annual wind. The wind angles which were run are indicated in Appendix 01.

On-site and local wind speeds were combined with wind statistics from 30 years of data recorded at Heathrow Airport corrected for variations in terrain between the airport and the site, to obtain annual and seasonal frequency and magnitude of wind speeds across the model. This allows the 'grading' of the pedestrian level winds according to the Lawson Comfort Criteria, which are explained later in this report.

The mean correction factors between the site and the airport are shown in Table 1.

The wind microclimate effects are assessed annually, for the winter months (December, January and February) and for the summer months (June, July, August). Winter conditions are reported as this is the season when the strongest winds are expected, summer conditions are reported as this is the season when pedestrian usage of outdoor spaces is expected to be highest.

2.3 LIMITATIONS AND ASSUMPTIONS

The accuracy of the results is dependent upon the accuracy of the CAD used to construct the model.

The assessment herein is valid to the design as supplied to GIA at the time of the assessment, and does not cover future variations in the design.

There is an inherent assumption that on-site wind speeds will scale linearly with the measured wind speeds at the airport.

There is an inherent assumption that the wind speed statistics for the past 30 years will remain applicable for the foreseeable future.

Table 01: Site Wind Correction Factors

DIRECTION (°N)	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Corr. Factor	1.41	1.42	1.44	1.43	1.39	1.45	1.46	1.51	1.46	1.41	1.41	1.4



Fig. 01: 3D View of proposed Development



Fig. 02: Proposed Development with Existing Surrounds

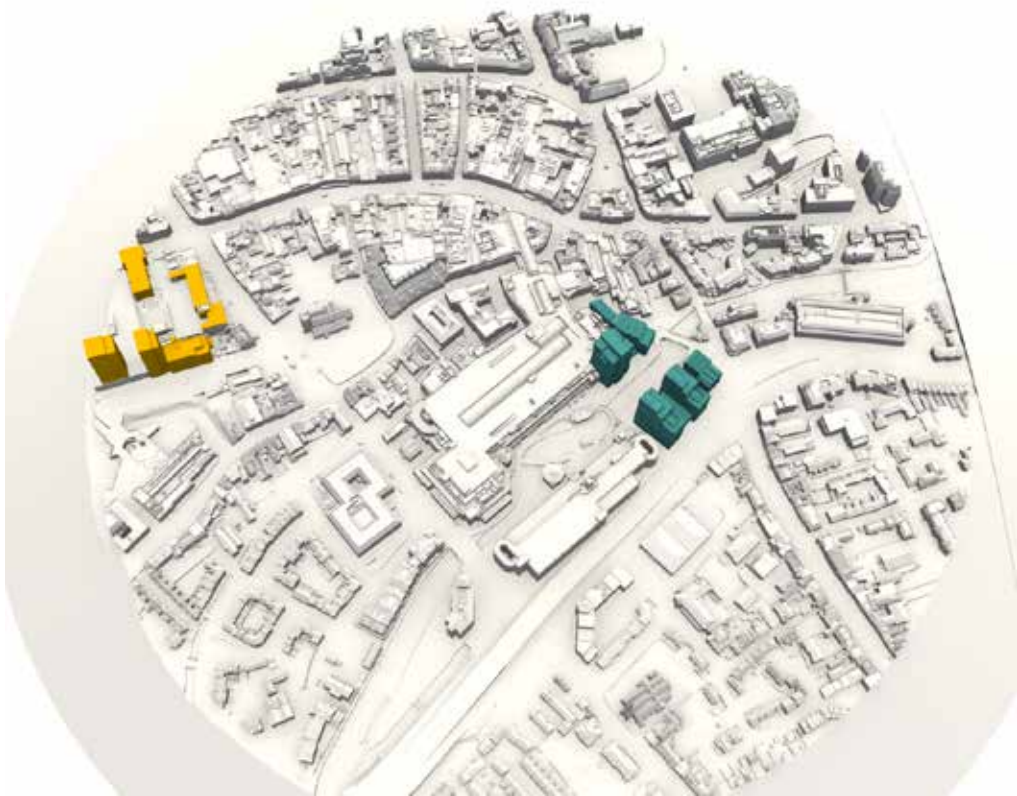


Fig. 04: Proposed Development with Cumulative Surrounds



Fig. 03: Sensitive Wind Receptors at Ground Floor

2.4 LAWSON COMFORT AND SAFETY CRITERIA

The assessment was graded against the Lawson Comfort and Safety Criteria.

Table 2 and Table 3 show the banding of the various categories within the Lawson Comfort and Safety criteria.

Comfort categories are based on the level of wind speed exceedance for 5% of each season, and safety categories are based on the level of wind speed exceedance for ~2 hours per year.

The assessment was performed using the London Docklands Development Corporation (LDDC) variant of the Lawson Comfort Criteria. The Lawson Criteria are well-established in the UK for quantifying wind conditions in relation to build developments and, although not a UK ‘standard’, the criteria are recognised by local authorities as a suitable benchmark for wind assessments. The Lawson Criteria have been adopted for this assessment.

Table 02: Lawson Comfort Criteria (LDDC variant)

KEY	COMFORT CATEGORY	MEAN WIND SPEED (5% EXCEEDANCE)	DESCRIPTION
	Sitting	4 m/s	Acceptable for outdoor sitting use (e.g. cafés, benches, balconies and terraces)
	Standing	6 m/s	Acceptable for main building entrances, pick-up / drop-off points and bus stops
	Walking (leisure)	8 m/s	Acceptable for strolling
	Walking (business)	10 m/s	Acceptable for external pavements, walking purposefully without lingering
	Uncomfortable	>10 m/s	Not comfortable for regular pedestrian access

Table 03: Lawson Safety Criteria (LDDC variant)

KEY	SAFETY CATEGORY	MEAN WIND SPEED (0.025% EXCEEDANCE)	DESCRIPTION
	No Safety Exceedance	<15 m/s	
	S15 (Distress)	>15 m/s	Unsafe for frail individuals, or cyclists
	S20 (Safety)	>20m/s	Wind conditions considered unsafe for all users

For a mixed-use urban area within which the Site is located, the desired wind microclimate would typically need to have areas acceptable for sitting, standing (including at entrances of buildings) and walking use. A description of the comfort categories to classify wind conditions in accordance with is given below.

Any areas which show up as either unsafe (annually) or uncomfortable (for winter) will require mitigation, unless they are in locations where pedestrian access can be controlled in the event of strong winds. This applies to all thoroughfares (for pedestrians) and roads (for cyclists) around the Development.

Any entrances should be suitable for standing, to create a buffer between internal and external conditions.

Bus stops should be suitable for standing. There are bus stops on Queen's Road and London Street within the study area.

There is proposed enhanced public realm, around the Junction with London Street and Inner Distributor Road, along Yield Hall Place from junction of London Street to Minister Street and on Oracle Riverside. This is targeted to be suitable for a mixture of sitting and standing in summer.

There is a proposed pocket park to the north of Yield Hall Place. This is targeted to be suitable for a mixture of sitting and standing in summer.

There are existing seating areas outside of the restaurants by the Oracle Riverside. These are targeted to be suitable for sitting in summer.

There are proposed break-out seating areas around the proposed development. These are targeted to be suitable for sitting in summer.

There is proposed amenity in the form of terraces, at Levels 1, 9 and 19 in Yield Hall Place 1 and at Levels 2, 11 and 14 in Yield Hall Place 2. These spaces are targeted to be suitable for a mixture of sitting and standing in summer.

There are proposed balconies. These are private spaces, the use of which can be

controlled according to the individual user's preference, so can stand higher wind speeds than communal amenity spaces but are still required to be suitable for sitting or standing in summer conditions.

The locations of the key wind microclimate receptors at ground level are shown in Figure 4.

2.5 **TEST SCENARIOS**

The purpose of these tests was to compare conditions with and without the proposed development.

The following scenarios were tested:

- 1 Baseline: The site (as existing) with the existing buildings surrounding the site;
- 2 Proposed Development, Existing Surrounds: The completed and operational development with the baseline conditions surrounding the site; and
- 3 Proposed Development, Cumulative Surrounds: The completed and operational development with the baseline conditions surrounding the site as well as any local consented schemes which have not yet started construction.

Trees and soft landscaping were not included in the model, to ensure reasonable worst-case conditions were captured.

The following local consented schemes were included in the cumulative surrounds:

- Broad Street Mall (planning ref. 182137)
- 20 Hosier Street (planning ref. 182054)

3 RESULTS

3.1 BASELINE CONDITIONS

Annual safety for the baseline scenario is shown in Figure 5. Winter comfort for the baseline scenario is shown in Figure 6. Summer comfort for the baseline scenario is shown in Figure 7.

Winter conditions range between sitting, standing and leisure walking. Summer conditions range between sitting and standing.

All principal off-site entrances (marked "O" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

All bus stops within the study area (marked "B" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

The seating outside of the Oracle Riverside restaurants (marked "S1" in results figures) is suitable for sitting or standing in winter and sitting in summer. This is suitable for the intended use,

There is a localised region of S15 (distress) exceedance at the western end of the Riverside Car Park building (marked "1" in Figure 5). This could pose a potential safety risk to frail individuals or cyclists during times of high wind speeds.

3 RESULTS (Continued)



Fig. 05: Annual Safety, Baseline

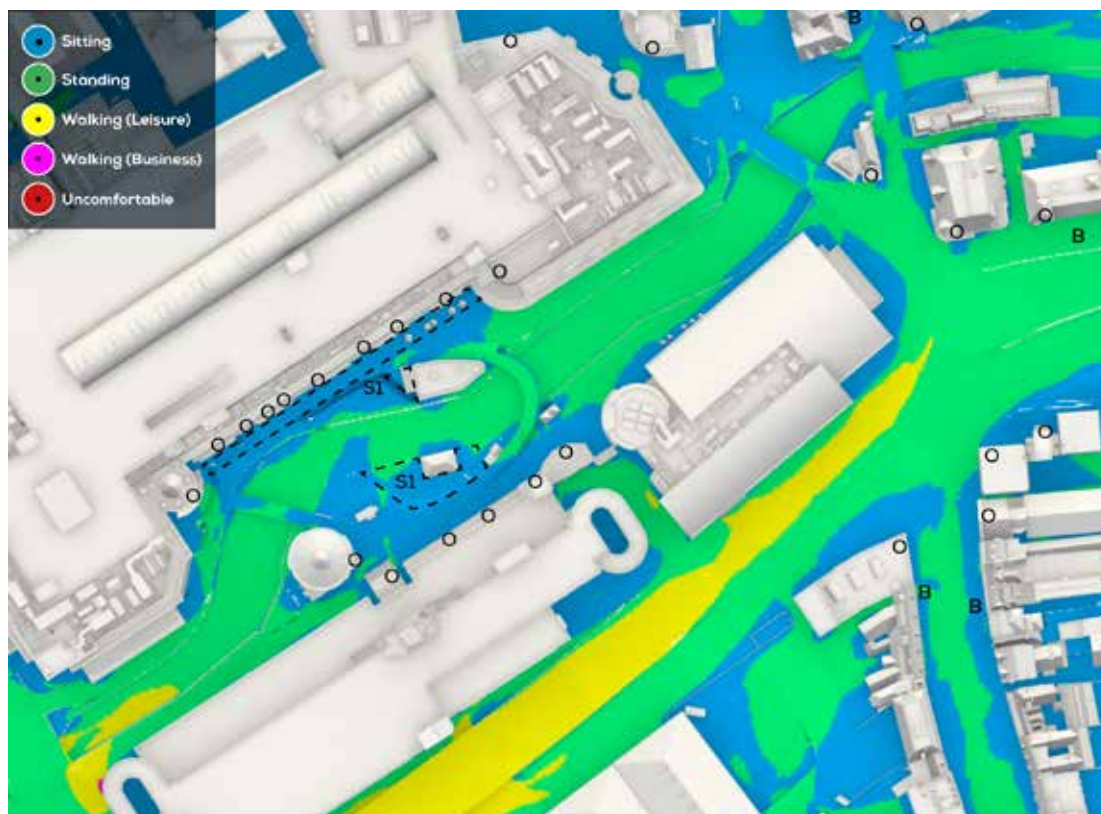


Fig. 06: Winter Comfort, Baseline

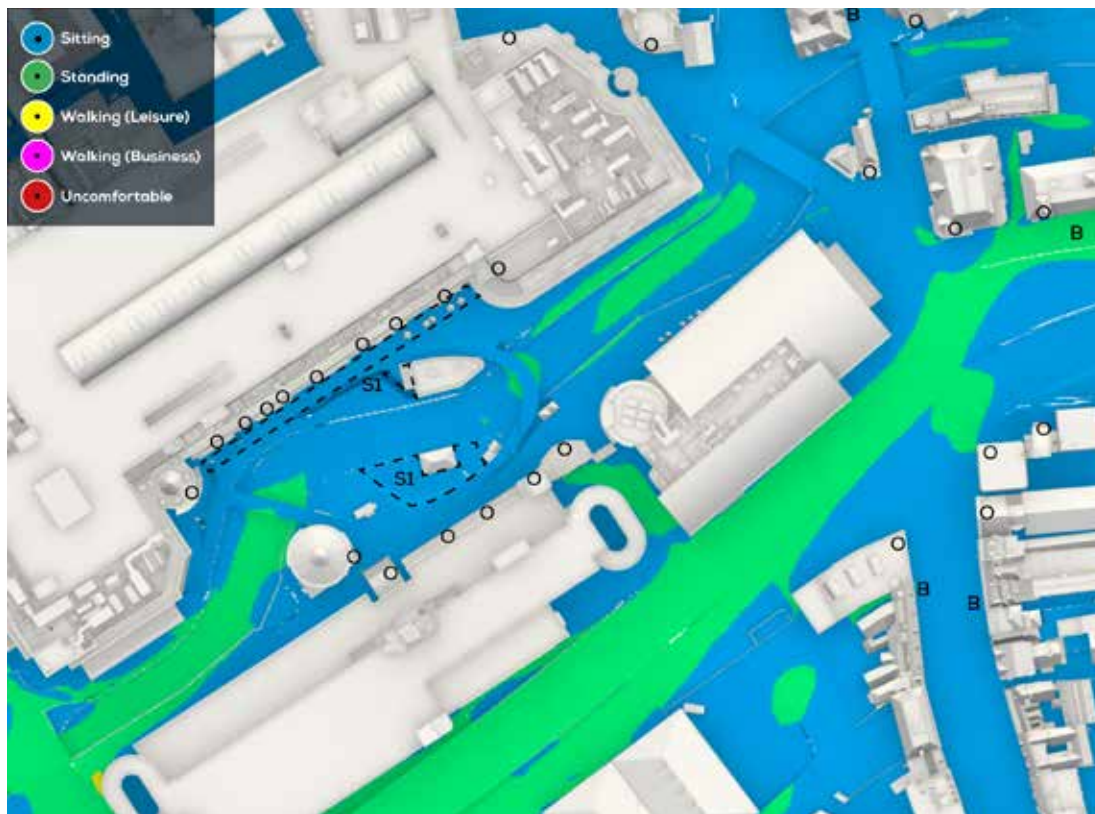


Fig. 07: Summer Comfort, Baseline

3.2 CONDITIONS FOR PROPOSED DEVELOPMENT WITH EXISTING SURROUNDS

Annual safety at ground level for the proposed development with existing surrounds is shown in Figure 8 Winter comfort at ground level for the proposed development with existing surrounds is shown in Figure 9. Summer comfort at ground level for the proposed development with existing surrounds is shown in Figure 10.

Winter conditions range between sitting, standing and leisure walking. Summer conditions range between sitting and standing.

All principal off-site entrances (marked "O" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

All bus stops within the study area (marked "B" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

The seating outside of the Oracle Riverside restaurants (marked "S1" in results figures) is suitable for sitting in all seasons. This is suitable for the intended use.

All principal entrances to the proposed development (marked "E" in results figures) are suitable for either sitting or standing in all seasons. This is suitable for the intended use.

The proposed enhanced public realm (marked with solid black lines in results figures) is suitable for a mixture of sitting, standing and leisure walking in winter and for a mixture of sitting and standing in summer. This is suitable for the intended use.

The proposed pocket park (marked "P" in results figures) is suitable for a mixture of sitting and standing in winter and for sitting in summer. This is suitable for the intended use.

The proposed break-out seating (marked "S2" in results figures) ranges between suitable for sitting and standing in all seasons. There is only a minimal seating area which is suitable for standing, which is both only marginally above

the threshold wind speed and located adjacent to significant tree planting. As such, conditions for the seating areas will be suitable for the intended use.

The pre-existing localised region of S15 (distress) exceedance at the western end of the Riverside Car Park building (marked "1" in Figure 8) has been reduced in extent, but a new region of S15 (distress) exceedance has been introduced at the eastern end of the Riverside Car Park building (marked "2" in Figure 8). The net effect to the safety risk around the Riverside Car Park building is therefore negligible, and it should also be noted that location 1 (where the proposal has lowered the wind safety risk) is likely a more populous area than the back-of-house location 2 (where the proposal has increased the wind safety risk, but is on a low-use region that does not intersect the cycle-path between the Riverside Car Park and Yield Hall Place 2).

Annual safety at terrace and balcony level for the proposed development with existing surrounds is shown in Figure 11. Winter comfort at terrace and balcony level for the proposed development with existing surrounds is shown in Figure 12. Summer comfort at terrace and balcony level for the proposed development with existing surrounds is shown in Figure 13

There are no regions of wind safety risk for the Yield Hall Place 1 level 1 terrace, Yield Hall Place 1 Level 6 terrace, South-Eastern Yield Hall Place 1 Level 19 terrace or the Yield Hall Place 2 Level 2 terrace.

The north western Yield Hall Place 1 Level 19 terrace and the Yield Hall Place 2 Level 11 terrace have thin regions of S15 exceedance at the perimeters of the terraces, but these are outside of the terrace railings so will not be accessible to terrace users and is not a significant safety risk.

The Yield Hall Place 2 Level 14 terrace has very thin regions of S15 exceedance which extend beyond the railing into the terrace itself at the north western and south western perimeters. This could pose a risk to the safety of frail terrace users, but would be straightforward

to mitigate by either replacing the railing at the north west and south west perimeters of this terrace with solid balustrades, or by slightly reducing the size of the accessible terrace to ensure the regions of safety risk cannot be accessed by users.

Conditions for the Yield Hall Place 1 level 1 and level 6 terraces are suitable for a mixture of sitting and standing in all seasons. This is suitable for the intended use.

Conditions for the south eastern Yield Hall Place Level 19 terrace are suitable for standing in winter and a mix of sitting and standing in summer. This is suitable for the intended use.

Conditions for the north western Yield Hall Place 1 terrace are suitable for a mix of standing and leisure walking in winter and for standing in summer. This is suitable for use as a viewing terrace, and could be made suitable for sitting by the inclusion of a solid balustrade around the perimeter.

Conditions for the Yield Hall Place 2 Level 2 terrace are suitable for a mix of standing and leisure walking in winter and for a mix of sitting and standing in summer. It should be noted that there is likely to be extensive tree planting on this terrace which would also increase the extent which is suitable for sitting. This is suitable for the intended use.

Conditions for the Yield Hall Place Level 11 and level 14 terraces are suitable (within the railings) for a mix of sitting, standing and leisure walking in winter and a mix of sitting and standing in summer. This is suitable for the intended use.

There are no significant regions of wind safety or distress risk at any balcony level. Balcony conditions range between suitable for sitting, standing and leisure walking in winter and between sitting and standing in summer. This is suitable for the intended use.



Fig. 08: Annual Safety, Proposed Development with Existing Surrounds

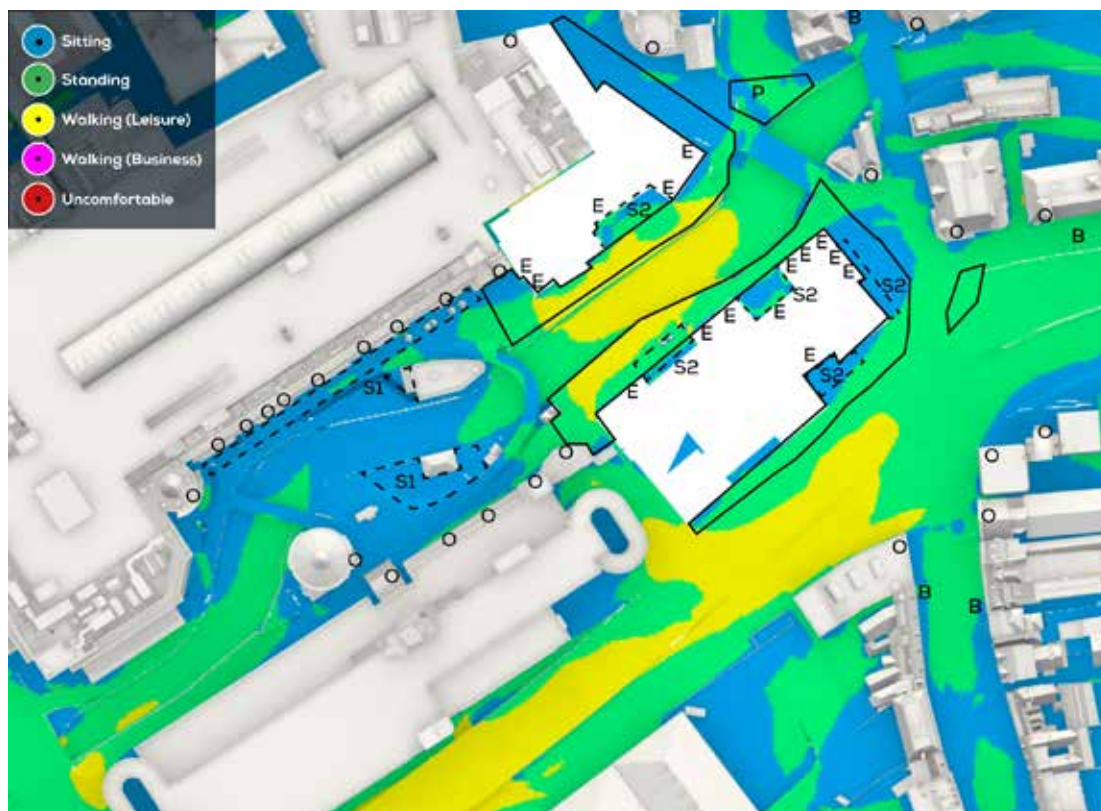


Fig. 09: Winter Comfort, Proposed Development with Existing Surrounds



Fig. 10: Summer Comfort, Proposed Development with Existing Surrounds

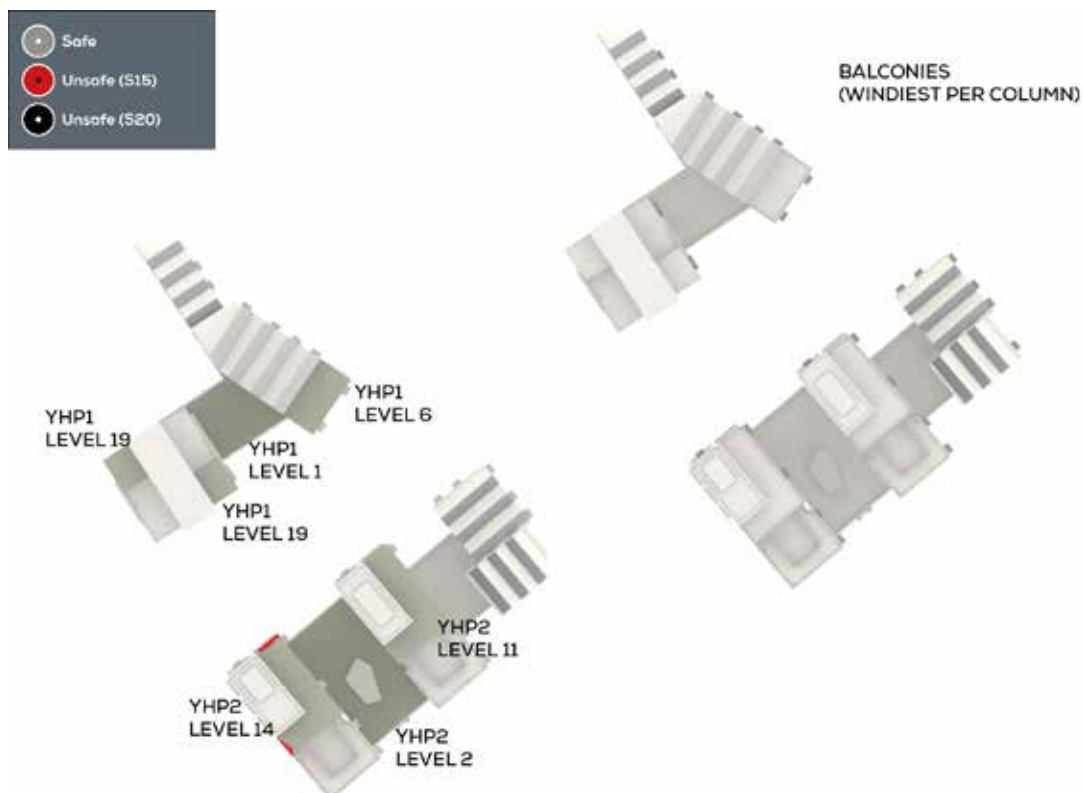


Fig. 11: Annual Safety at Terrace and Balcony Levels, Proposed Development with Existing Surrounds

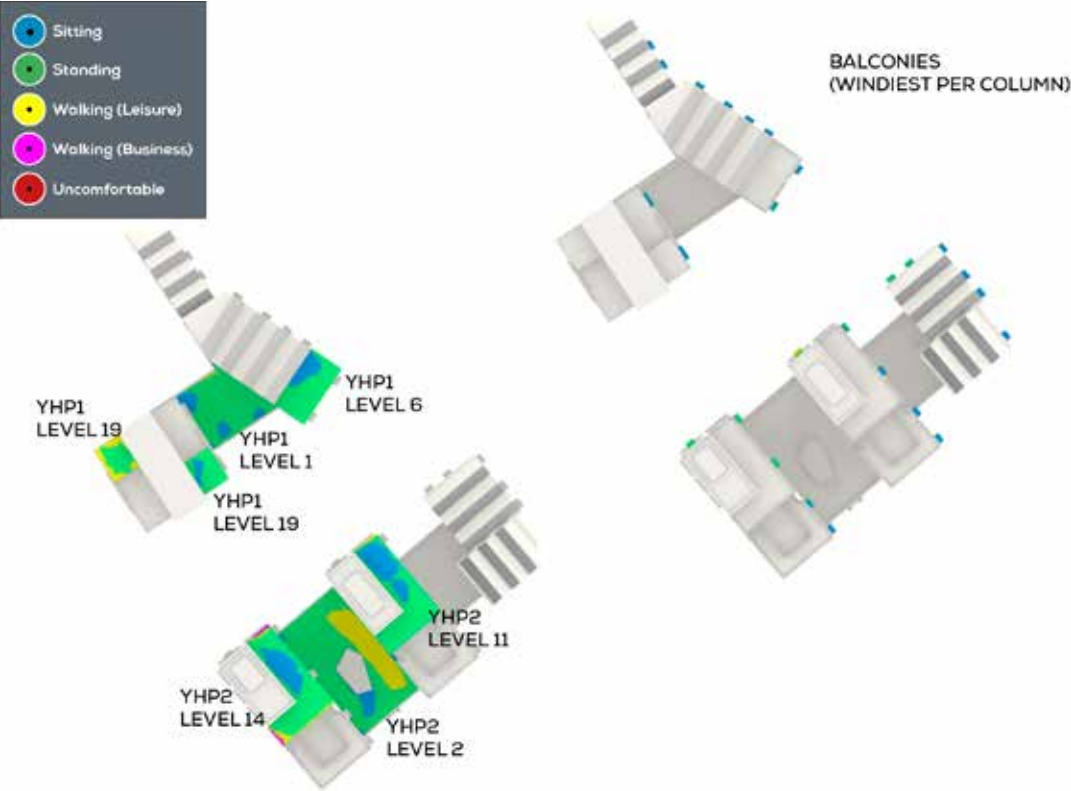


Fig. 12: Winter Comfort at Terrace and Balcony Levels, Proposed Development with Existing Surrounds

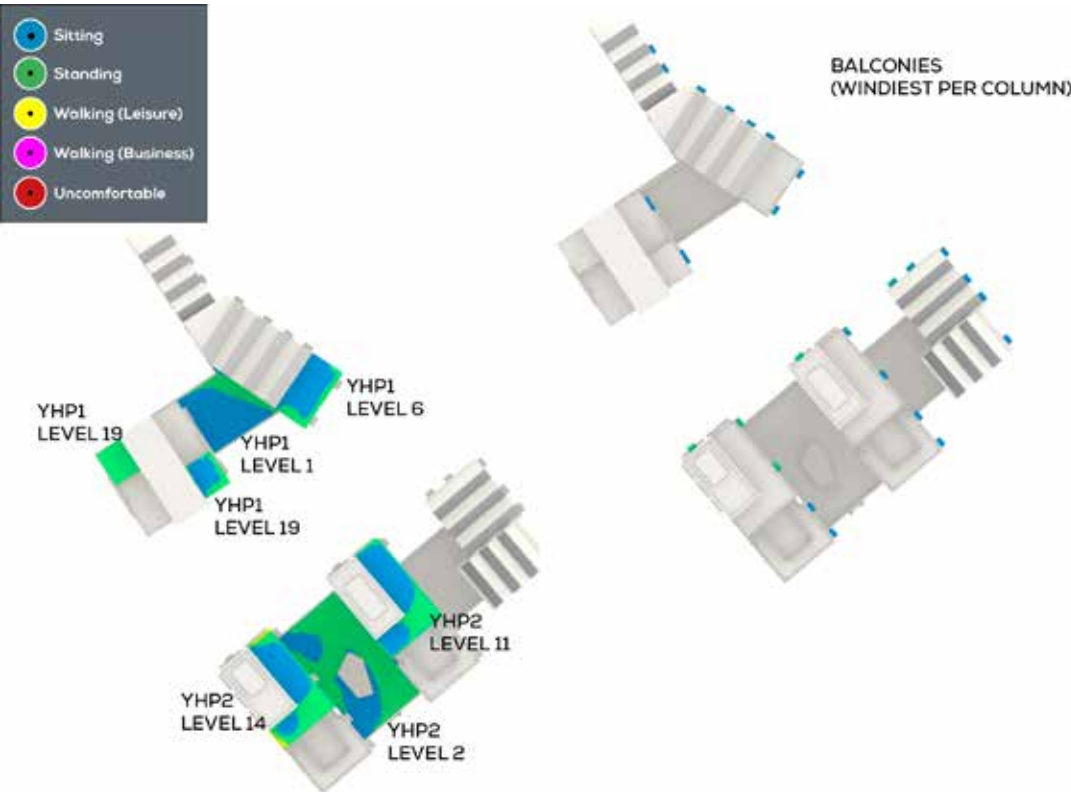


Fig. 13: Summer Comfort at Terrace and Balcony Levels, Proposed Development with Existing Surrounds

3.3 **CONDITIONS FOR PROPOSED DEVELOPMENT WITH CUMULATIVE SURROUNDS**

Annual safety at ground level for the proposed development with cumulative surrounds is shown in Figure 14. Winter comfort at ground level for the proposed development with cumulative surrounds is shown in Figure 15. Summer comfort at ground level for the proposed development with cumulative surrounds is shown in Figure 16.

Annual safety at terrace and balcony level for the proposed development with cumulative surrounds is shown in Figure 17. Winter comfort at terrace and balcony level for the proposed development with cumulative surrounds is shown in Figure 18. Summer comfort at terrace and balcony level for the proposed development with cumulative surrounds is shown in Figure 19.

The S15 (distress) exceedance which had been recorded in the location marked 2 on Figure 14 has been eradicated, and there are no ground level safety risks associated with the proposed development.

With the exception of the above, there are no other material differences between conditions for the proposed development with existing surrounds and for the proposed development with cumulative surrounds.



Fig. 14: Annual Safety, Proposed Development with Cumulative Surrounds

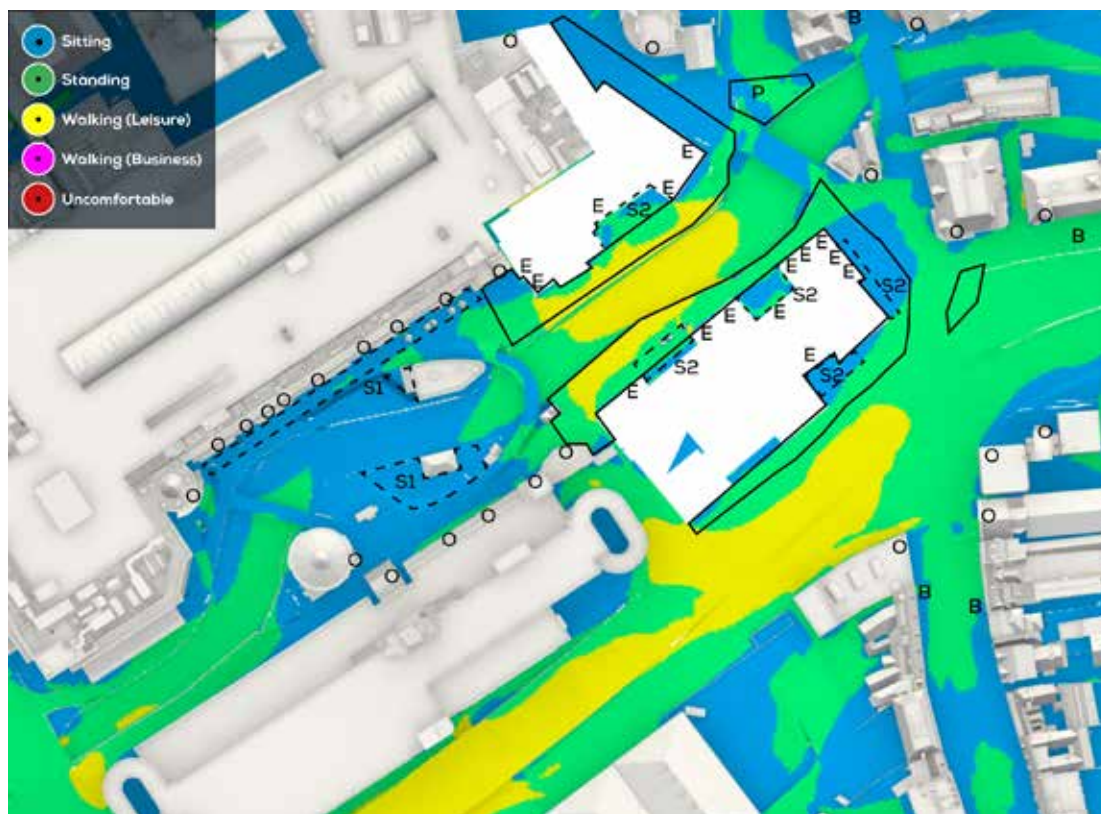


Fig. 15: Winter Comfort, Proposed Development with Cumulative Surrounds



Fig. 16: Summer Comfort, Proposed Development with Cumulative Surrounds

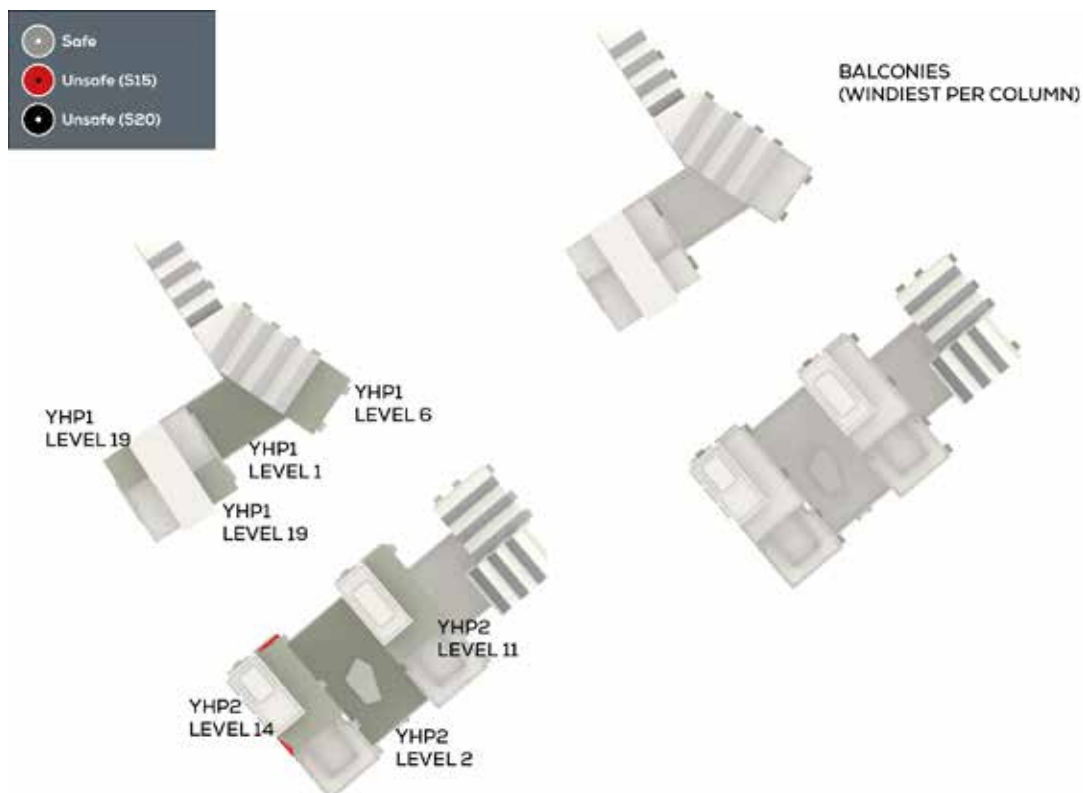


Fig. 17: Annual Safety at Terrace and Balcony Levels, Proposed Development with Cumulative Surrounds

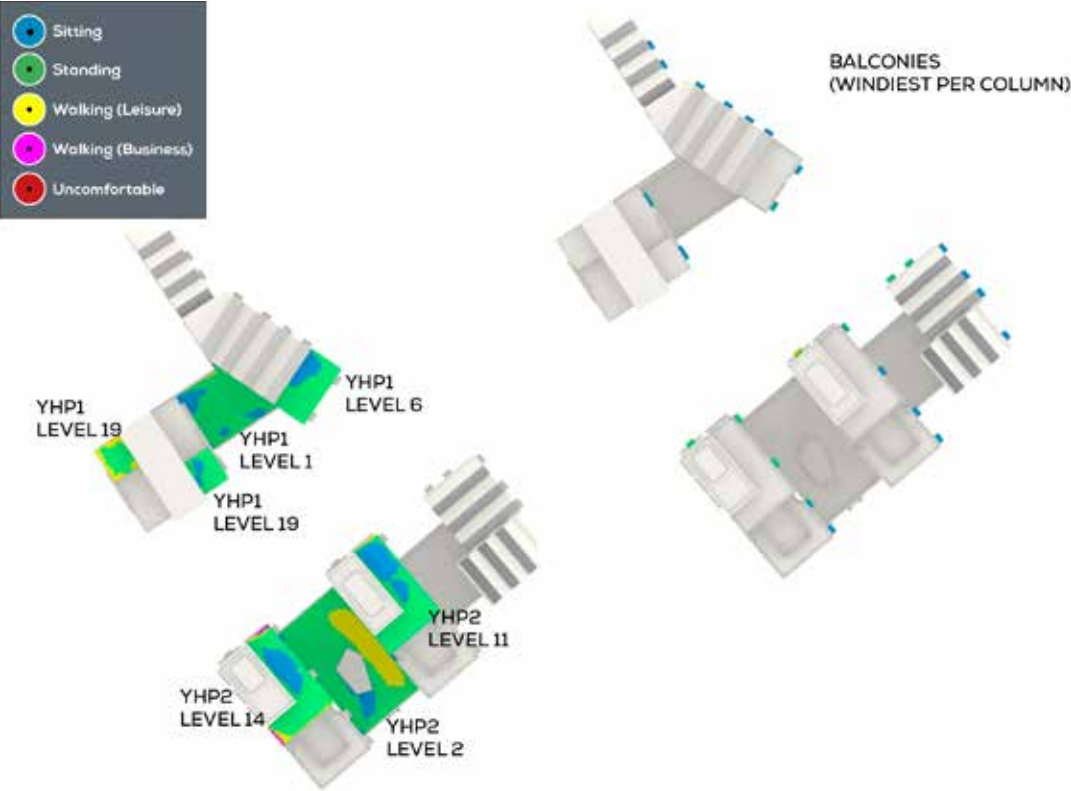


Fig. 18: Winter Comfort at Terrace and Balcony Levels, Proposed Development with Cumulative Surrounds

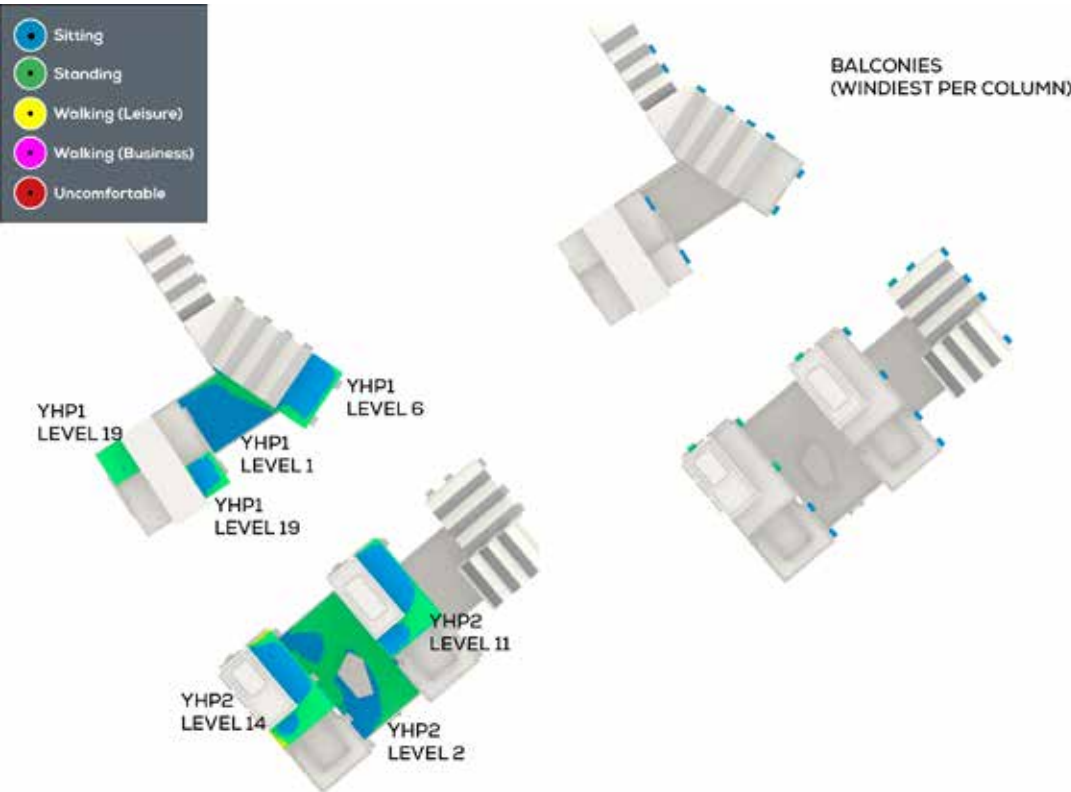


Fig. 19: Summer Comfort at Terrace and Balcony Levels, Proposed Development with Cumulative Surrounds

4 CONCLUSIONS

Wind microclimate conditions for the proposed development known as The Oracle, Reading were assessed using high resolution CFD.

All ground level wind comfort conditions are expected to be suitable, including thoroughfares, on and off-site building entrances, existing seating areas and proposed seating areas.

All wind comfort conditions for the balconies and level 2 terraces on both Yield Hall Place 1 and Yield Hall Place 2 will be suitable for the intended use.

The inclusion of the proposed development reduces the extent and severity of a region of S15 (distress) exceedance to the west of the Riverside Car Park building, but introduces a localised region of S15 (distress) exceedance to the east of the Riverside Car Park building. As the region of the pre-existing S15 exceedance to the west is a relatively populated area, and the region of the introduced S15 exceedance to the east is a back of house area, the overall impact of the proposed development on the wind safety risk in the local area can be viewed as between net even to net beneficial.

As local future schemes come forward, the introduced S15 (distress) exceedance to the east of the car park is eradicated, and there are no wind safety risks associated with the proposed development.

The level 14 terrace for Yield Hall Place 2 would require either solid balustrades at the north west and south west perimeters, or a marginal reduction in size from these edges, to ensure that there is no safety risk to terrace users.

The north western level 19 terrace for Yield Hall Place 1 would require a solid balustrade around the perimeter in order to have suitable conditions for sitting out in summer.

APPENDIX 01

DETAILED METHODOLOGY

CFD METHODOLOGY

The CFD was performed using OpenFOAM.

Meshed using a hybrid mesh of hexahedral, polyhedral, tetrahedral and prismatic elements:

- On site building edge length: 0.05m – 0.25m
- Surrounding context edge length: 0.25m – 1m

Prismatic cells were used in the boundary layer region, with 4 layers of cells growing with an expansion ratio of 1.15 and aspect ratios between 0.1 and 0.4.

The total mesh size was between 107 and 111 million cells. Mesh detail is shown in Figure 20 and Figure 21.

Buildings within 400m of the site were included.

The domain was 5000mx5000m, with a blockage ratio of 0.5%

The blockage ratio uses a “test section” of 600mx200m (within which detail is captured).

Run using the SST turbulence model with high Re wall functions to ensure mesh suitability.

The simulations were steady state and isothermal.

2nd order discretisation schemes were used.

Convergence was measured as the residuals of the continuity, x-velocity, y-velocity, z-velocity, k and omega equations all falling by at least 2 orders of magnitude, and by measured static pressure on the site buildings varying by less than 1% over the final 100 iterations.

The wind speed is corrected into a “gust-equivalent” mean. The gust-equivalent mean is calculated using an empirical relationship between the gust and mean ratios recorded at over 13,000 data points from wind tunnel tests. This method is found to give a significant correlation improvement over the more traditional methods based on the CFD turbulent kinetic energy field.

WIND CLIMATE METHODOLOGY

The simulations were performed from 18 wind directions, spaced such that no single direction contributed more than 10% of the annual winds.

The directions simulated were 0°, 30°, 60°, 90°, 120°, 150°, 180°, 200°, 210°, 220°, 230°, 240°, 250°, 260°, 270°, 280°, 300°, 330°.

Seasonal wind roses for London Heathrow are shown in Figure 22.

Target wind profiles for the site, from each wind direction, were generated using sectoral analysis of the terrain surrounding the site and the local weather stations with ESDU 2010 Item 01008 ‘Computer program for wind speeds and turbulent properties: flat or hilly sites in terrain with roughness changes’. The target wind profiles, compared to the wind speeds measured from the CFD model are shown in Figure 23.

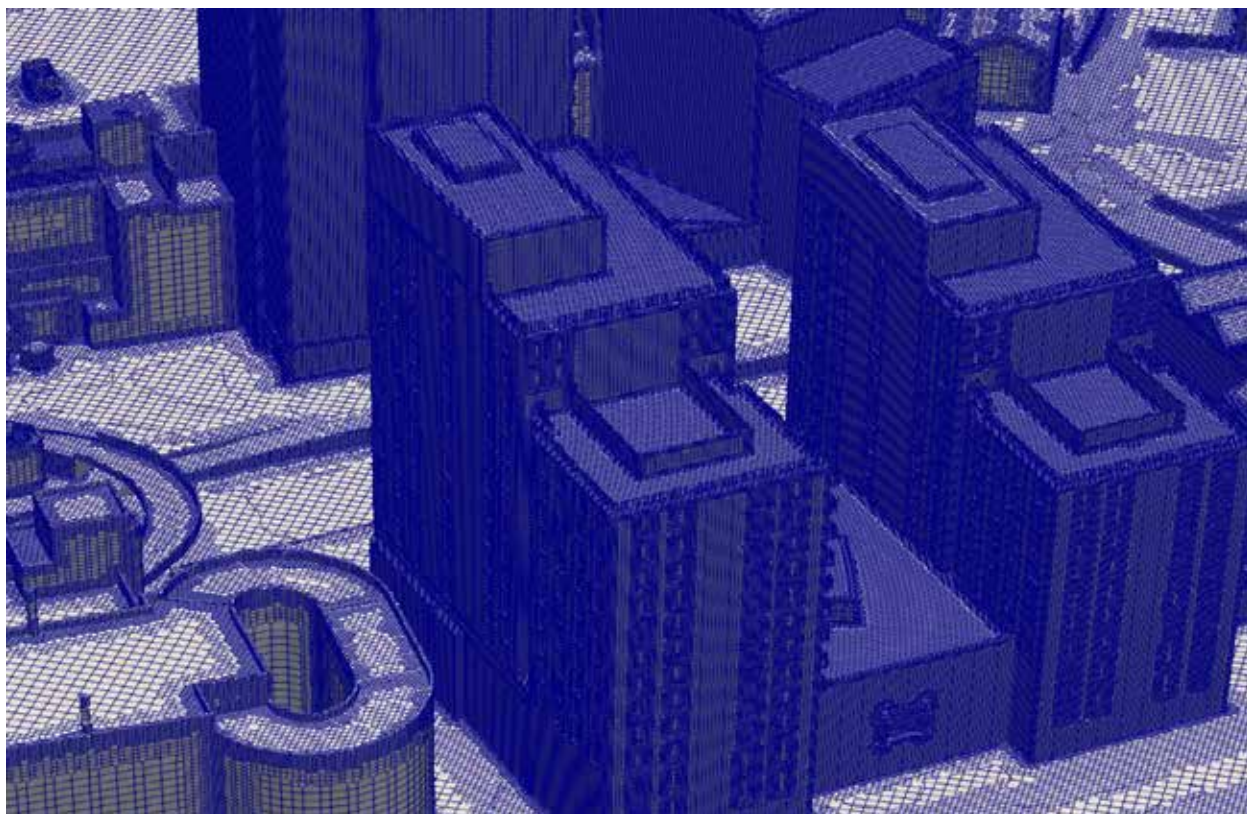


Fig. 20: Mesh Detail on Site Buildings

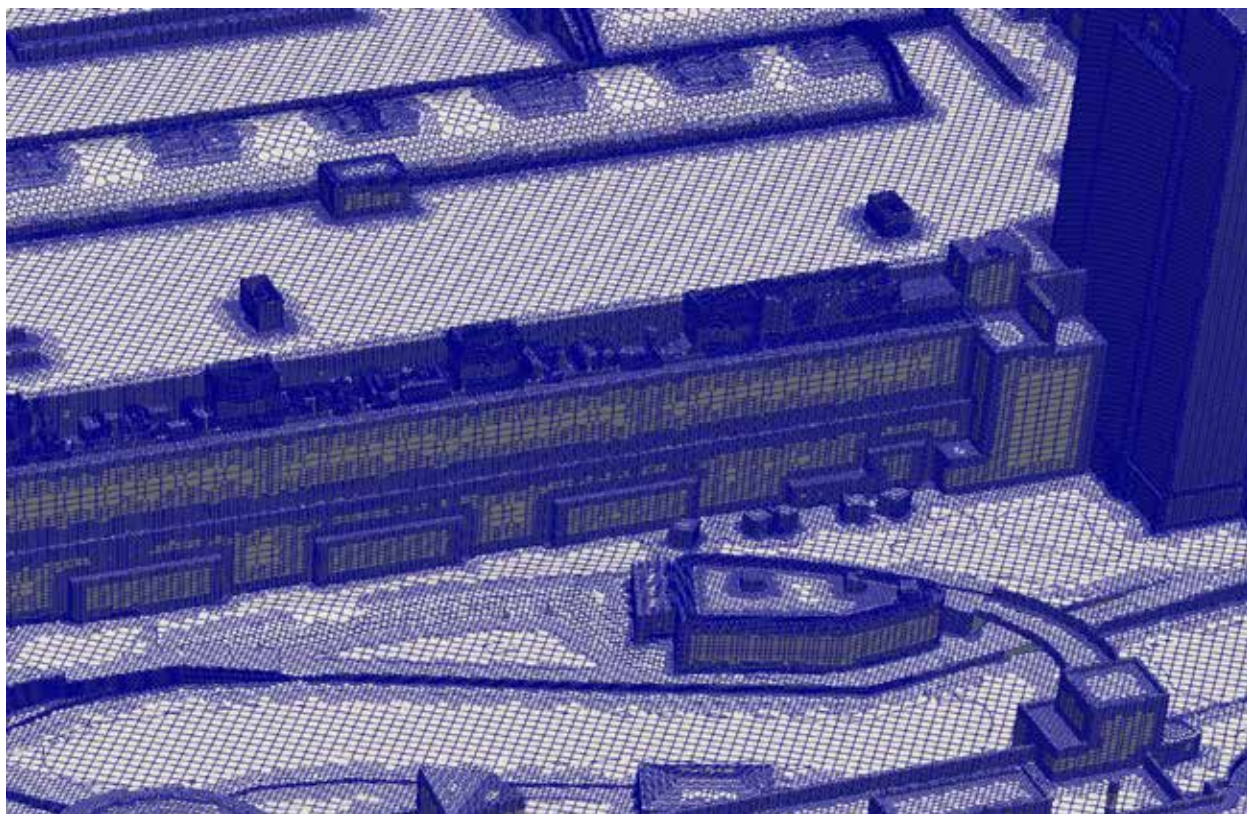


Fig. 21: Mesh Detail on Surrounds



Fig. 22: Seasonal Wind Roses for Heathrow Airport (1990-2020)

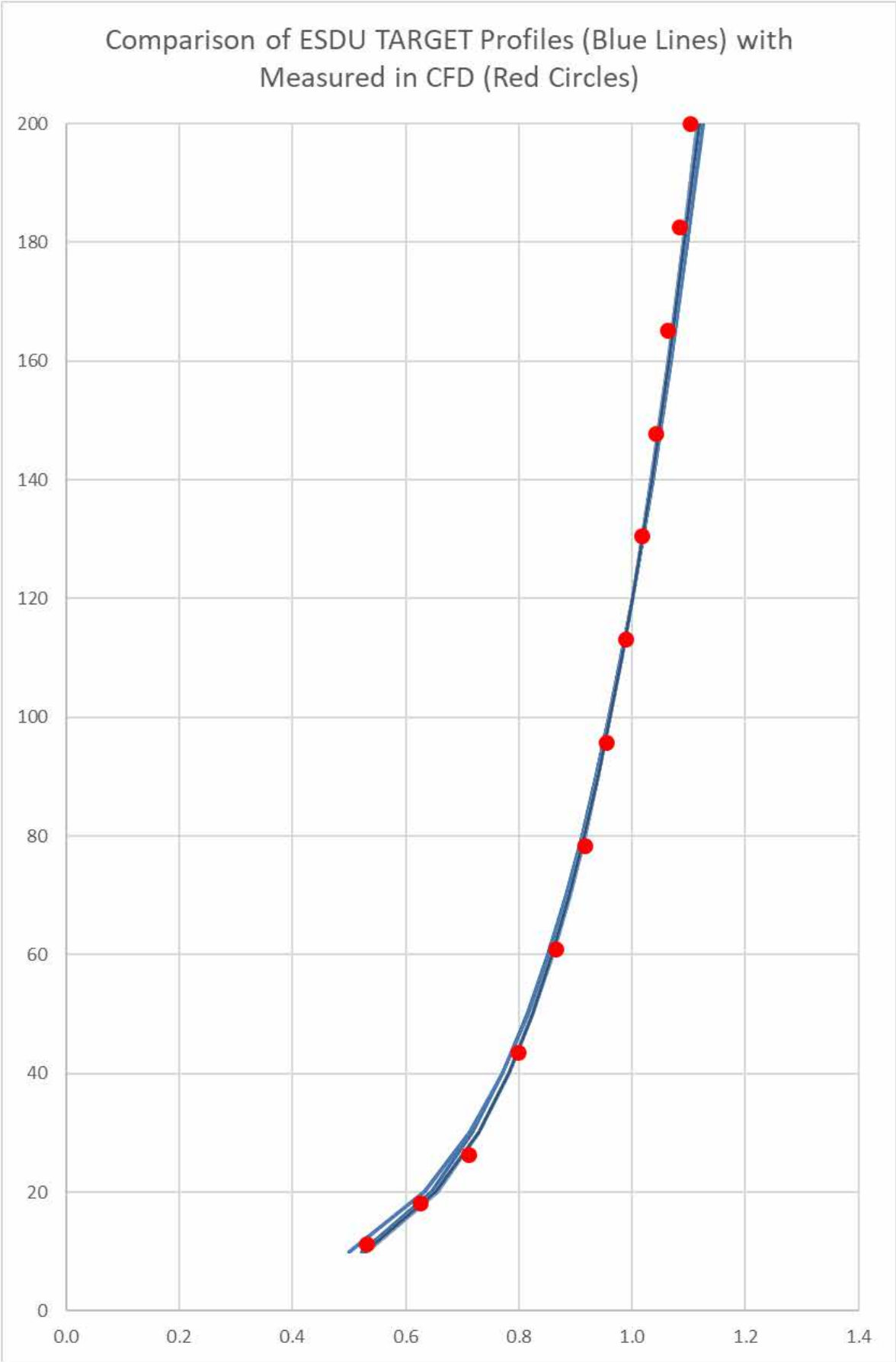


Fig. 23: Wind Profile for Reading



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