REPORT

189 SUMMERSET DRIVE, BLOCK 76

BARRIE, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2206145

AUGUST 16, 2022

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a pedestrian wind assessment for the proposed project at 189 Summerset Drive in Barrie, Ontario. The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development in support of the Site Plan Control Application (SPA).

The project site is located at the northeast corner of the intersection of Summerset Drive/Mapleton Avenue and Ardagh Road, surrounded by low-rise suburban neighbourhoods in most directions and dense forests from the west through the north (Image 1).

The project is a residential development that will consist of a 6-storey apartment building including units, 156 back-to-back 3-storey townhouse units, and 64 block cluster townhouse units that are also 3-storey in height. In addition to sidewalks and properties near the project site, key areas of interest for this assessment include outdoor amenity areas on the site, as well as the main entrances and the multitenant rooftop terrace of the apartment building (Image 3).

Image 1: Aerial view of the existing site and surroundings (Credit: Google Maps)

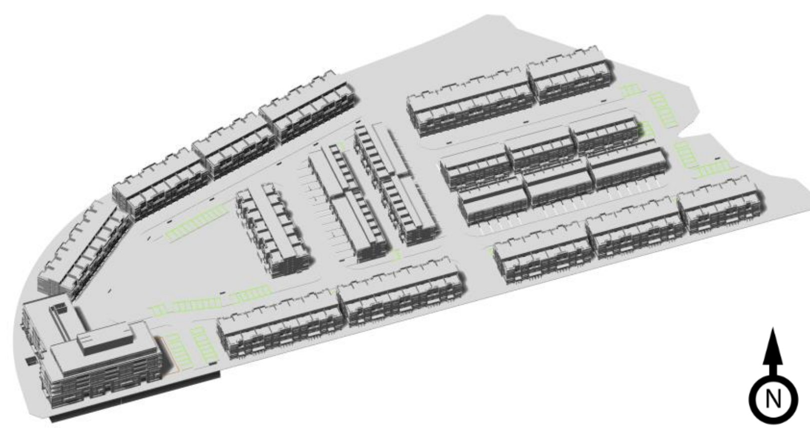


Image 2: Conceptual massing

1. INTRODUCTION

: MAIN ENTRANCE

: OUTDOOR AMENITY AREA

Image 3: Site plan

2. METHODOLOGY

2.1 Objective

The objective of this assessment is to provide an evaluation of the potential impact of the proposed development on wind conditions in pedestrian areas on and around it based on Computational Fluid Dynamics (CFD) modelling. The assessment is based on the following:

- A review of the regional long-term meteorological data from Egbert Climate Station ;
- Design drawings and 3D e-model of the proposed project received on July 12 and 21, 2022;
- The use of *Orbital Stack*, an in-house CFD tool;
- The use of RWDI's proprietary tool WindEstimator[1] for estimating the potential wind conditions around generalized building forms;
- Wind tunnel studies completed by RWDI for similar projects in this region and around the world;
- RWDI's engineering judgment, experience, and expert knowledge of wind flows around buildings[1-3]; and,
- The RWDI wind comfort and safety criteria.

Note that other microclimate issues such as those relating to cladding and structural wind loads, door operability, air quality, snow impact, noise, vibration, etc. are not part of the scope of this assessment

2.2 CFD for Wind Simulation

CFD is a numerical technique for simulating wind flow in complex environments. For modelling winds around buildings, CFD techniques are used to generate a virtual wind tunnel where flows around the site, surroundings and the study building are simulated at full scale. The computational domain that covers the site and surroundings are divided into millions of small cells where calculations are performed, which allows for the "mapping" of wind conditions across the entire study domain. CFD excels as a tool for wind modelling and presentation for providing early design advice, comparing different design and site scenarios, resolving complex flow physics, and helping diagnose problematic wind conditions.

Gust conditions are infrequent but deserve special attention due to their potential impact on pedestrian safety. The computational modelling method used in the current assessment does not quantify the transient behaviour of the wind, including wind gusts. The effect of gust, i.e., wind safety, is predicted qualitatively in this assessment using analytical methods and wind-tunnel-based empirical models[1]. The assessment has been conducted by experienced microclimate specialists in order to provide an accurate prediction of wind conditions.

In order to quantify the transient behavior of wind and refine any conceptual mitigation measures, physical scale-model tests in a boundary-layer wind tunnel or more detailed transient computational modelling would be required.

2.3 Simulation Model

CFD simulations were completed for two scenarios:

- Existing: Existing site and surroundings, and
- Proposed: Proposed project with the existing surroundings.

The computer model of the proposed development and the assessed scenarios are shown in Images 4 through 6. The models were simplified to include only the necessary building and terrain details that would affect the local wind flows in the area and around the site. Landscaping and other smaller architectural and accessory features were not included in the computer model in order to provide more conservative wind conditions (as is the norm for this level of assessment).

Wind approaching the modelled area from 16 directions (starting at 0°, at 22.5° increments around the compass), were simulated, accounting for the effects of the atmospheric boundary layer and terrain impacts. Wind data in concerned areas were obtained in the form of ratios of wind speeds at approximately 1.5m above concerned levels, to the mean wind speed at a reference height. The data was then combined with meteorological records obtained from Egbert Climate Station to determine the wind speeds and frequencies in the areas of concern. Pedestrian level wind conditions were evaluated for the time period from 6AM to 11PM for the summer (May to October) and winter (November to April) seasons.

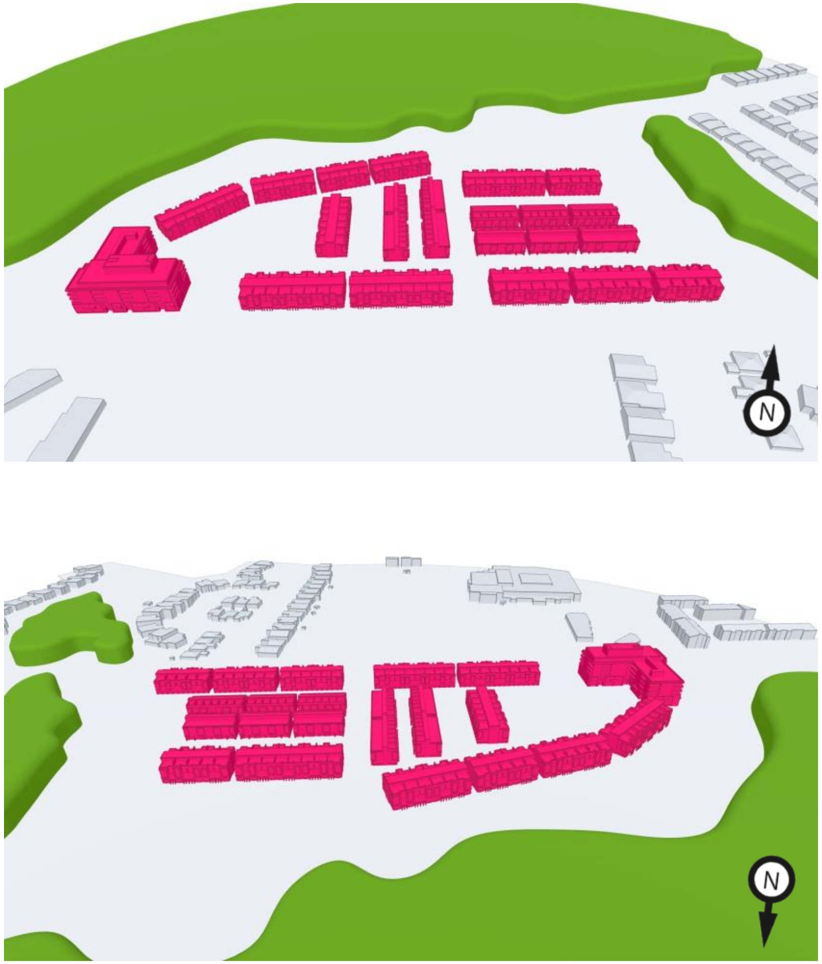


Image 4: Computer model of the proposed project

Image 5: Computer model of the existing site and extended surroundings

2. METHODOLOGY

Image 6: Computer model of the proposed project and extended surroundings

2. METHODOLOGY

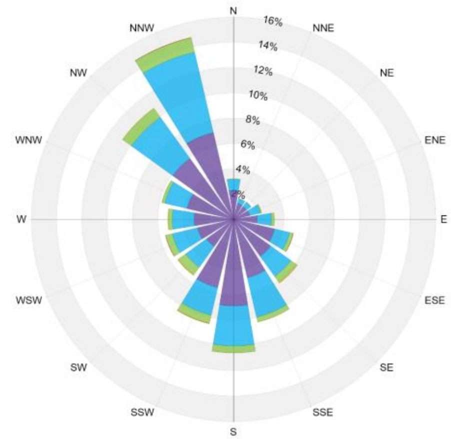
2.4 Meteorological Data

Long-term wind data recorded at Egbert Climate Station between 2004 and 2021, inclusive, were analyzed for the summer (May to October) and winter (November to April) months. Image 6 graphically depicts the directional distributions of wind frequencies and speeds for these periods.

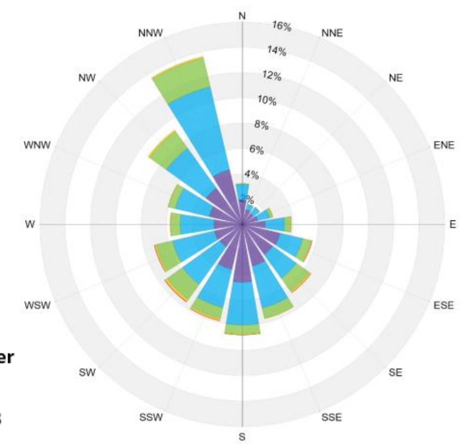
Winds from the northwest are predominant and winds from the southwest and southeast quadrants are also prevalent in both summer and winter, as indicated by the wind roses.

Strong winds of a mean speed greater than 20 km/h measured at the airport (at an anemometer height of 10m) can travel from all predominant wind directions and are more frequent during the winter (green and yellow bands in Image 6).

Wind statistics were combined with the simulated data to predict the wind conditions at the project site and assessed against the wind criteria for pedestrian comfort.



Summer
(May through October)



Winter
(November through April)

Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	1.8	1.0
1-10	57.6	42.3
11-20	33.7	41.9
21-30	6.6	13.5
31-40	0.3	1.1
>40	0.0	0.1

Image 7: Directional distribution of wind approaching Egbert Climate Station (2004 to 2021)

3. WIND CRITERIA

The RWDI pedestrian wind criteria are used in the current study; the criteria presented in the table below, addresses pedestrian safety and comfort. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities, building designers and the city planning community.

Pedestrian Comfort

Pedestrian comfort is associated with common wind speeds conducive to different levels of human activity. Wind conditions are considered suitable for sitting, standing, strolling or walking if the associated mean wind speeds (see table) are expected for at least four out of five days (**80% of the time**). The assessment considers winds occurring between 6:00 and 23:00. Nightly hours between 0:00 and 5:00 are excluded from the comfort assessment since limited usage of outdoor spaces is anticipated in that period. Speeds that exceed the criterion for Walking are categorized Uncomfortable. These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

Comfort Category	GEM Speed (mph)	Description (Based on seasonal compliance of 80%)
Sitting	≤ 10	Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away
Standing	≤ 14	Gentle breezes suitable for main building entrances, bus stops, and other places where pedestrians may linger
Strolling	≤ 17	Moderate winds appropriate for window shopping and strolling along a downtown street, plaza or park
Walking	≤ 20	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
Uncomfortable	> 20	Strong winds considered a nuisance for all pedestrian activities. Wind mitigation is typically recommended

Pedestrian Safety

Pedestrian safety is associated with excessive Gust Speeds that can adversely affect a person's balance and footing. These are usually infrequent events but deserve special attention due to the potential impact on pedestrian safety.

Safety Criterion	Gust Speed (mph)	Description (Based on annual exceedance of 9 hrs or 0.1% of time)
Exceeded	> 90	Excessive gusts that can adversely affect one's balance and footing. Wind mitigation is typically required.

4. RESULTS AND DISCUSSION

4.1 Wind Flow Around the Project

Wind generally tends to flow over buildings of uniform height, without disruption. Buildings that are taller than their surroundings tend to intercept and redirect winds around them. The mechanism in which winds are directed down the height of a building is called *Downwashing*. These flows subsequently move around exposed building corners, causing a localized increase in wind activity due to *Corner Acceleration*. Stepped massing, low roofs and canopies deflect downwash and reduce the potential wind impact on the ground level. These flow patterns are illustrated in Image 7.

The project, at 3 storeys (townhouses) and 6 storeys (apartment building), are considered low or moderate in height when the potential wind impact is concerned. Therefore, the project is not expected to redirect winds significantly and cause adverse impacts on the local wind conditions.

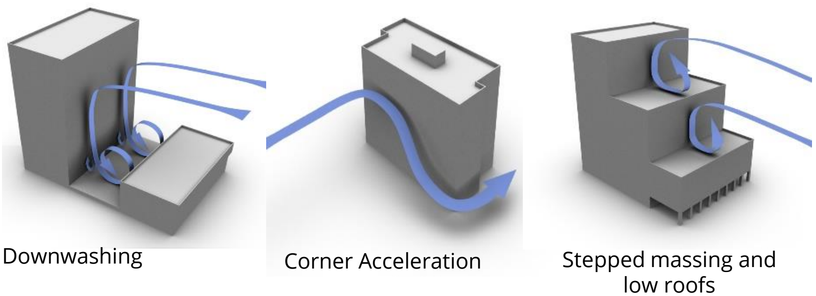


Image 8: General wind flow patterns

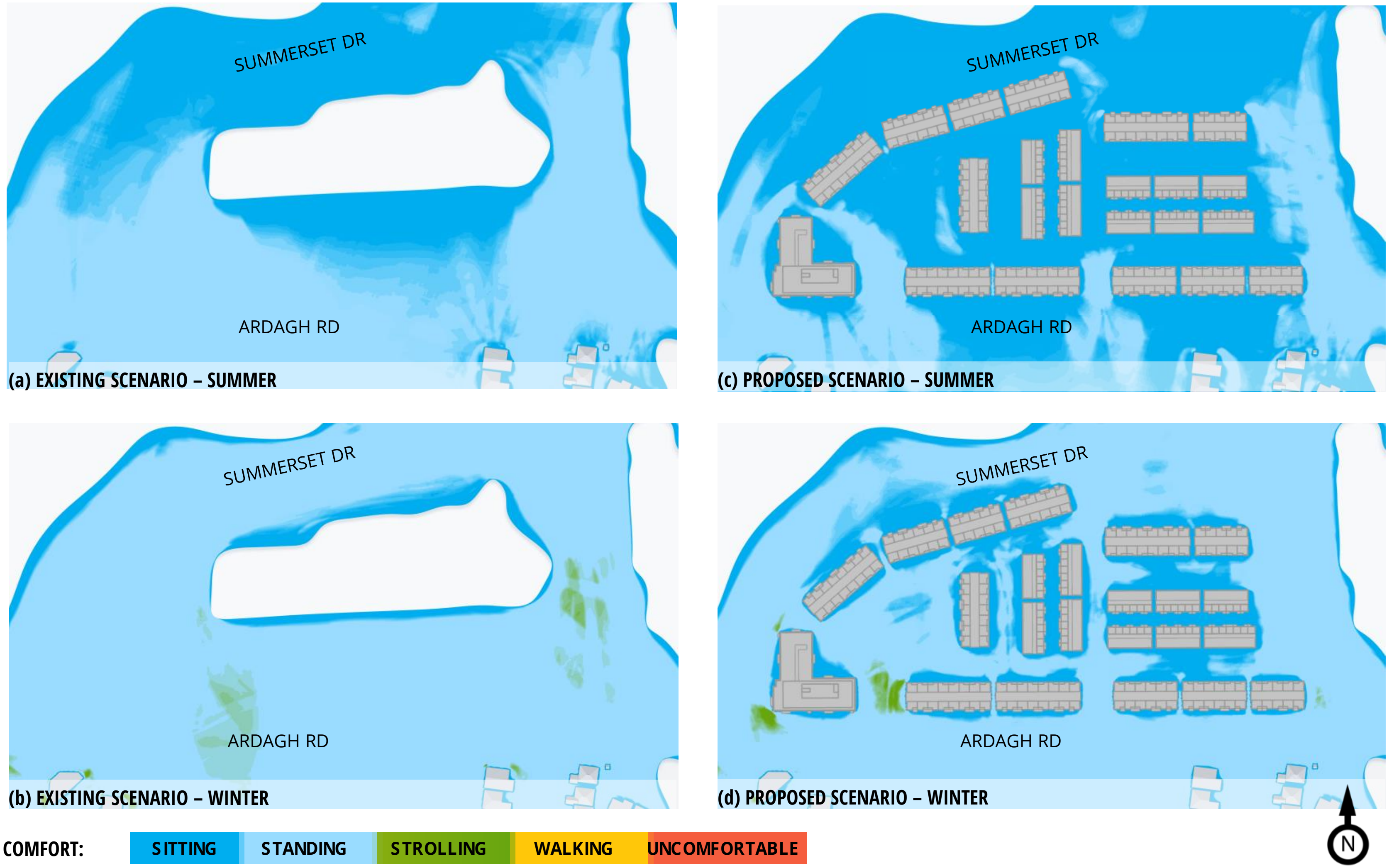
4.2 Simulation Results

The predicted wind comfort conditions for the existing and proposed configurations are presented in Images 9a through 9d for the summer and winter. The results are presented as colour contours of wind speeds calculated based on the wind criteria (Section 3.2), approximately 1.5 m above the concerned level.

The assessment against the safety criterion (Section 3.1) was conducted, based on the predicted wind conditions and our extensive experience with wind tunnel assessments. Wind conditions at all areas assessed meet the safety criterion.

For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks and walkways where pedestrians are likely to be active and moving intentionally. Lower wind speeds comfortable for standing are required for entrances and areas where people are expected to be engaged in passive activities. Calm wind speeds suitable for sitting are desired in areas where prolonged periods of passive activities are anticipated, such as outdoor amenity areas, especially during the summer when these areas are typically in use. A detailed discussion of the expected wind conditions with respect to the prescribed criteria and applicability of the results follows in Sections 4.3. and 4.4. The discussion includes recommendations for wind control, where needed, to reduce the potential for high wind speeds for the design team's consideration.

4. RESULTS AND DISCUSSION



COMFORT: SITTING | STANDING | STROLLING | WALKING | UNCOMFORTABLE

Image 9: Predicted wind conditions – GROUND LEVEL

4.3 Existing Scenario

The existing site is surrounded by low-rise buildings and forests in all directions and is therefore sheltered from winds. Wind conditions across the site are comfortable for sitting or standing throughout the year (Images 9a and 9b), which is considered suitable for the general pedestrian uses of this area.

Wind speeds at all areas near the project site are expected to meet the safety criterion.

4.4 Proposed Scenario

4.4.1 Ground Level

Due to the low or moderate height of the proposed project, the impact of the project will be limited, and wind conditions on neighbouring properties are not expected to be worsened.

The resulting wind speeds at most areas on and around the project, including the main entrances to the apartment building and outdoor amenity spaces on the property, are expected to continue to be comfortable for sitting or standing year-round (see Images 9c and 9d for conditions across the project site and Images 10a and 10b for conditions near apartment entrances). These conditions are appropriate for the intended pedestrian activities.

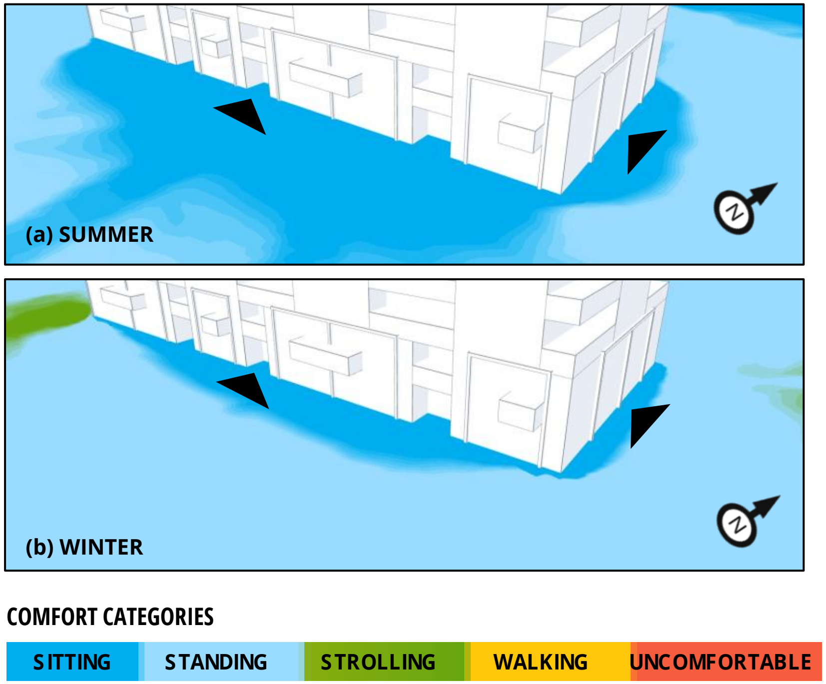
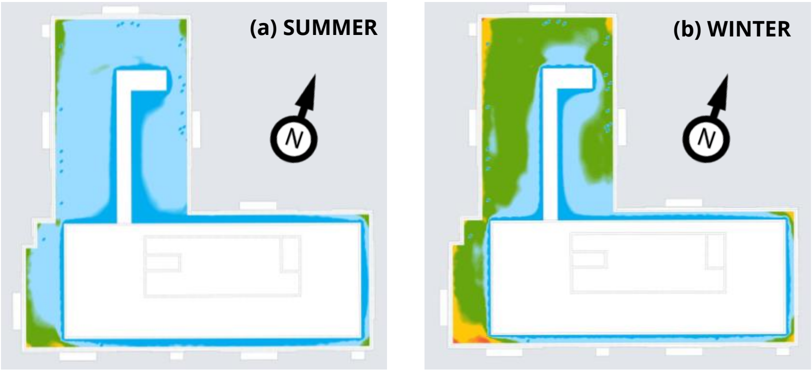


Image 10: Predicted wind conditions – ENTRANCES

4.4.2 Apartment Building Rooftop Terrace

On the rooftop terrace of the apartment building, summer wind conditions are predicted to be comfortable for standing at most areas and strolling near corners, which are appropriate for passive patron uses (Image 11a). During the winter, outdoor amenity spaces like this will not be occupied frequently in this region, and increased wind activity may be considered acceptable (Image 11b).

If desired, wind control features can be installed to further improve the comfort level on the rooftop and allow for passive activities. Some examples can include raised guardrails (approx. height of 2m) along the terrace perimeter, wind screens, and/or landscaping features around seating areas (see image 12 for photo illustrations).



COMFORT CATEGORIES

SITTING	STANDING	STROLLING	WALKING	UNCOMFORTABLE

Image 11: Predicted wind conditions – ROOFTOP TERRACE

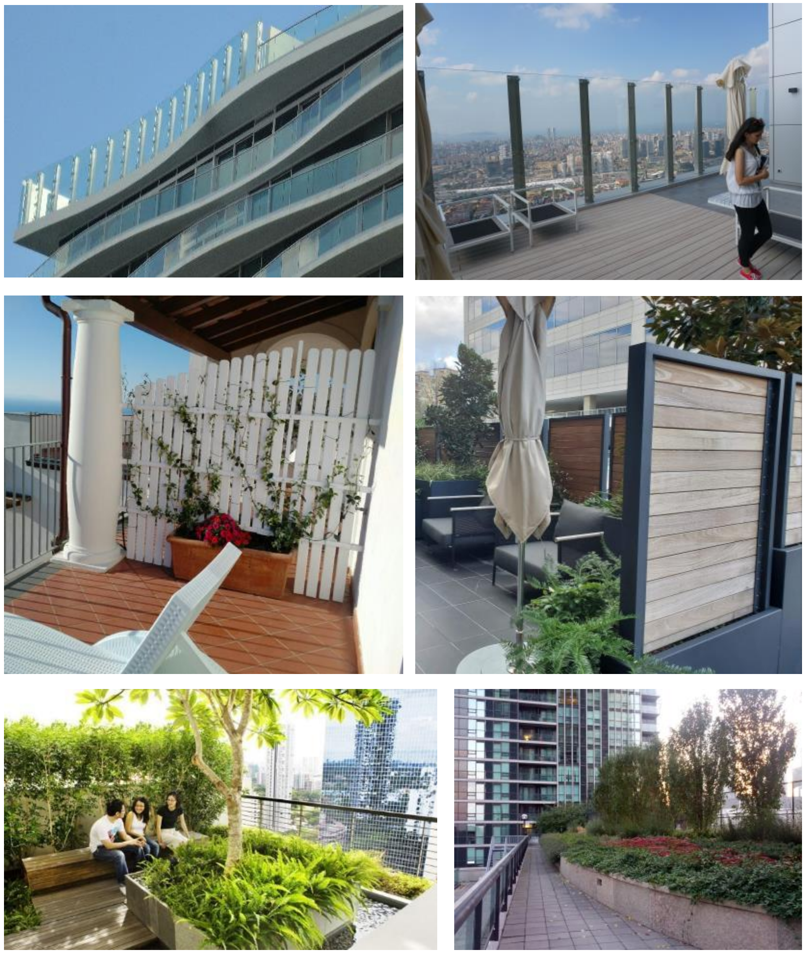


Image 12: Design strategies for wind control on rooftop terrace

5. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed project at 189 Summerset Drive in Barrie, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, and computational modelling and simulation of wind conditions. Our findings are summarized as follows:

- Wind conditions are suitable for pedestrian uses across the Existing site.
- With the introduction of proposed project, wind conditions at the ground level, including the main entrances, sidewalks, and amenity aeras, are expected to be suitable for the intended use throughout the year.
- Wind conditions are expected to be generally suitable for passive patron use on the rooftop terrace of the apartment building during the summer season. Wind control strategies to help further improve the comfort level have been proposed in the report for the design team's consideration.
- Wind speeds at all areas are expected to meet the pedestrian safety criterion in both configurations simulated.

6. DESIGN ASSUMPTIONS

The findings/recommendations in this report are based on the architectural drawings and building geometry communicated to RWDI, listed below. Should the details of the proposed design and/or geometry of the building change significantly, results may vary.

File Name	File Type	Date Received (mm/dd/yyyy)
22013 - BEA Condominium - Condo and Townhouse	PDF	07/12/2022
22013- BEA	DWG	07/21/2022

Changes to the Design or Environment

It should be noted that wind comfort is subjective and can be sensitive to changes in building design and operation that are possible during the life of a building. These could be, for example: outdoor programming, operation of doors, elevators, and shafts pressurizing the tower, changes in furniture layout, etc.. In the event of changes to the design, construction, or operation of the building in the future, RWDI could provide an assessment of their impact on the discussions included in this report. It is the responsibility of Others to contact RWDI to initiate this process.

7. STATEMENT OF LIMITATIONS

This report was prepared by Rowan Williams Davies & Irwin Inc. for Stateview Homes ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein and authorized scope. The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

7. REFERENCES

1. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), “Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions”, *ASCE Structure Congress 2004,* Nashville, Tennessee.

2. H. Wu and F. Kriksic (2012). “Designing for Pedestrian Comfort in Response to Local Climate”, *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.

3. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), “Experience with Remedial Solutions to Control Pedestrian Wind Problems”, *10th International Conference on Wind Engineering*, Copenhagen, Denmark.