1600 UPPER JAMES STREET

HAMILTON, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2304215
JULY 26, 2023

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a qualitative assessment of the pedestrian wind conditions expected on and around the proposed project at 1600 Upper James Street in Hamilton, Ontario. This effort is intended to inform good design and has been conducted in support of Zoning By-Law Amendment Application for the project.

The project site is located at the northwest corner of the intersection of Rymal Road West and Upper James Street (Image 1). The site is currently occupied by a one-storey commercial building and surrounded mainly by low-rise buildings and open lots in all directions.

The proposed project, shown in Image 2, consists of a 21-storey residential building with retail on the east side, and outdoor amenity spaces at and above grade.

Pedestrian areas of interest include building entrances, nearby sidewalks/walkways, as well as the outdoor amenity spaces at the ground floor and Level 7 (Image 3).

Image 1: Aerial View of the Existing Site and Surroundings (Credit: Google Earth)

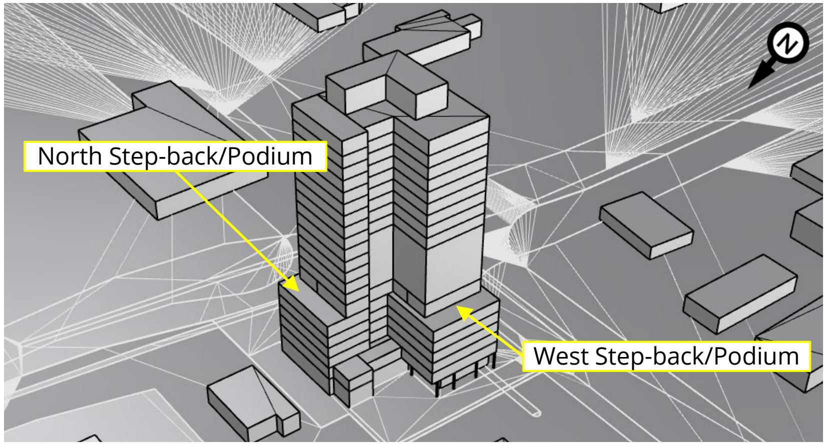

Image 2: 3D Model of the Proposed Project (Courtesy of Kirkor Architects and Planners)

Image 3: Floor Plans of the Proposed Project (Courtesy of Kirkor Architects and Planners)

2. METHODOLOGY

Predicting wind speeds and occurrence frequencies is complex. It involves the combined assessment of building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate.

Over the years, RWDI has conducted thousands of wind-tunnel model studies on pedestrian wind conditions around buildings, yielding a broad knowledge base. In some situations, this knowledge and experience, together with literature, allow for a reliable, consistent and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing. This approach provides a screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

In order to quantify and confirm the predicted conditions or refine any of the suggested conceptual wind control measures, physical scale model tests in a boundary-layer wind tunnel would typically be required.

RWDI's assessment is based on the following:

- Design drawings and 3D model received from Kirkor Architects and Planners on July 10, 2023;
- A review of the regional long-term meteorological data from Hamilton International Airport;
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- Wind-tunnel studies and desktop assessments undertaken by RWDI for similar projects in the area;
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3]; and,
- RWDI Criteria for pedestrian wind comfort and safety.

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

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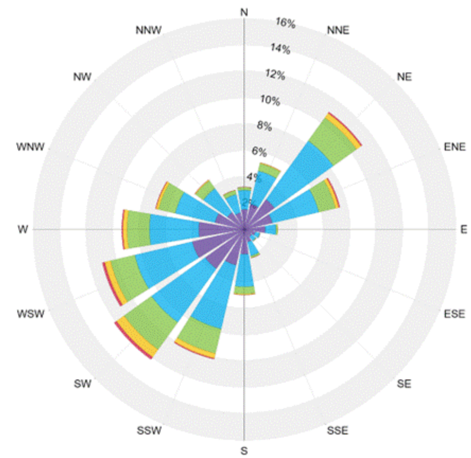
1. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.
2. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering 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.

3. METEOROLOGICAL DATA

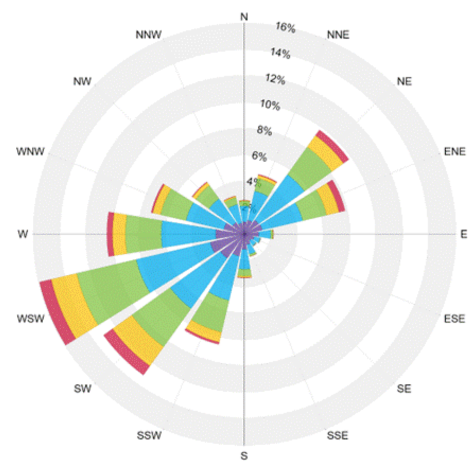
Meteorological data from Hamilton International Airport for the period from 1990 to 2020 were used as a reference for wind conditions in the area as this is the nearest station to the site with long-term, hourly wind data. The distributions of wind frequency and directionality for the summer (May through October) and winter (November through April) seasons are shown in the wind roses in Image 4.

When all winds are considered, winds from the southwest and northeast directions are predominant in both the summer and winter, as indicated by the wind roses.

Strong winds of a mean speed greater than 30 km/h measured at the airport (red and yellow bands) occur more often in the winter than in the summer season.



Summer (May through October)



Winter (November through April)

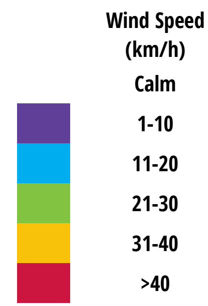


Image 4: Directional Distribution of Winds Approaching Hamilton International Airport (1990 to 2020)

4. WIND CRITERIA

The criteria specified in the Pedestrian Level Wind Study Terms of Reference Guide (March 2018) prepared by the city of Hamilton are used in the current study and are presented below. The criteria consider pedestrian comfort (pertaining to common wind speeds conducive to different levels of human activity) and safety (pertaining to infrequent but strong gusts that could affect a person's footing).

4.1 Safety Criterion

Pedestrian safety is associate with excessive gust that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (**≥ 90 km/h**) occur more than **0.1%** of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort Criteria

Wind comfort can be categorized by typical pedestrian activities:

Sitting (≤ 10 km/h): Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

Standing (≤ 14 km/h): Gentle breezes suitable for main building entrances and bus stops.

Strolling (≤ 17 km/h): Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.

Walking (≤ 20 km/h): Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

Uncomfortable: The comfort category for walking is not met.

Wind conditions are considered suitable for sitting, standing, strolling or walking if the associated mean wind speeds are expected for at least four out of five days (**80% of the time**). Wind control measures are typically required at locations where winds are rated as uncomfortable or they exceed the wind safety criterion.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height in an open terrain).

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.

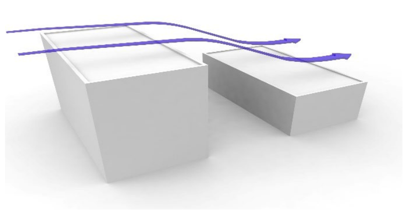
For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks and walkways as pedestrians will be active and less likely to remain in one area for prolonged periods of time. Lower wind speeds conducive to standing or sitting are preferred at main entrances where pedestrians are apt to linger. Wind speeds comfortable for sitting are preferred for areas intended for passive activities, such as the outdoor amenity spaces at and above grade.

5. RESULTS AND DISCUSSION

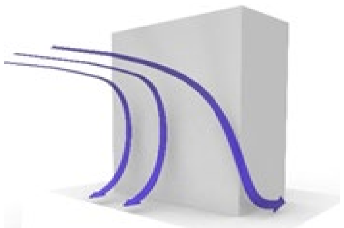
5.1 Wind Flow Around Buildings

Short buildings do not redirect winds significantly to cause adverse wind conditions at pedestrian areas (Image 5a). Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Downwashing). These winds subsequently move around exposed building corners, causing a localized increase in wind activity due to Corner Acceleration (Image 5b). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and *uncomfortable* conditions.

Design details such as stepped massing, tower step-back from a podium edge, deep canopies close to ground level, wind screens / tall trees with dense underplanting, etc. (Image 6) can help reduce wind speeds. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.

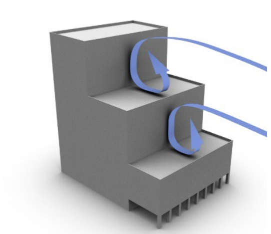


a) Wind flow over built terrain of uniform height

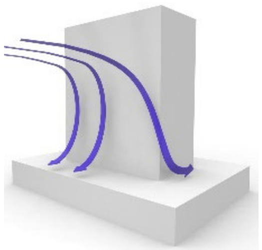


b) Downwashing and Corner Acceleration

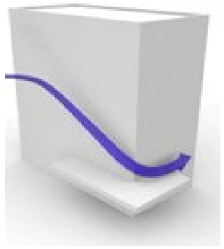
Image 5: Generalized Wind Flows



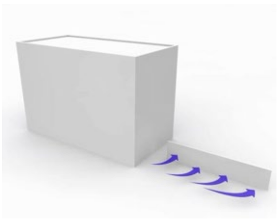
Stepped Massing



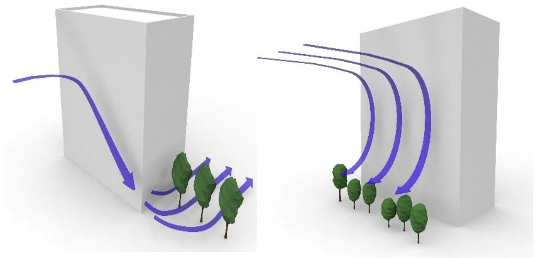
Podium



Canopy



Wind Screens



Landscaping

Image 6: Examples of Common Wind Control Measures

5.2 Existing Scenario

The existing site is currently occupied by a single one-storey commercial building and surrounded by mix of suburban neighbourhoods and open lots. As such, there are no significant structures that would deflect ambient winds to ground to cause adverse wind impacts. Currently, wind conditions at most areas on sidewalks around the site are considered comfortable for sitting or standing in the summer, and for standing or strolling in the winter. Wind conditions exceeding the safety criterion are not expected.

5.3 Proposed Scenario: Overview

The proposed building, at 21 storeys, will be significantly taller than buildings in all wind directions and, therefore, will be exposed to the prevailing winds. Downwashing and corner accelerating flows are predicted to result in increased wind activity around the building and nearby sidewalks with the highest speeds expected around the southeast corner of the building (Image 7).

Although the project will increase wind speeds in the immediate surroundings, several features of the building massing are favourable towards reducing the potential for severe wind impacts. Such features include:

- The corner articulations at the northwest side of the building;
- The large tower step-backs along the north and west façades of the building;
- The massing overhang in the west side of the building; and,
- The vestibules for the residential entrances.

The following sections provide a discussion of the potential wind conditions around the project, taking these features into account. The expected wind flow pattern and conditions are shown in Images 7 and 8.

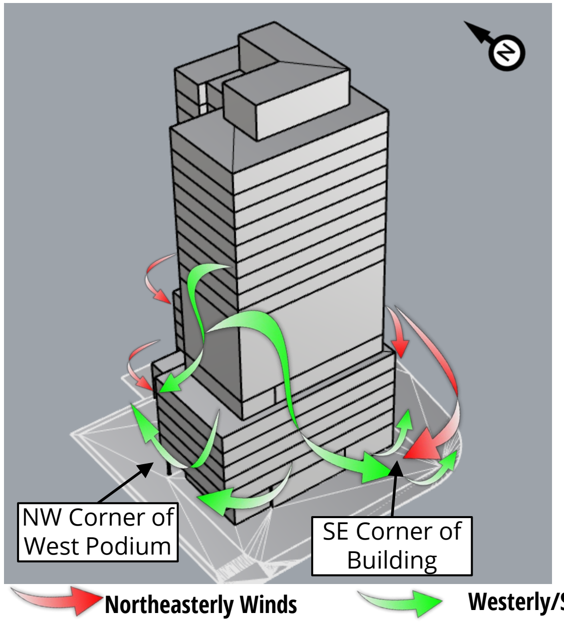


Image 7: Predicted Flow Pattern around the Proposed Building

5.4 Proposed Scenario: Wind Conditions

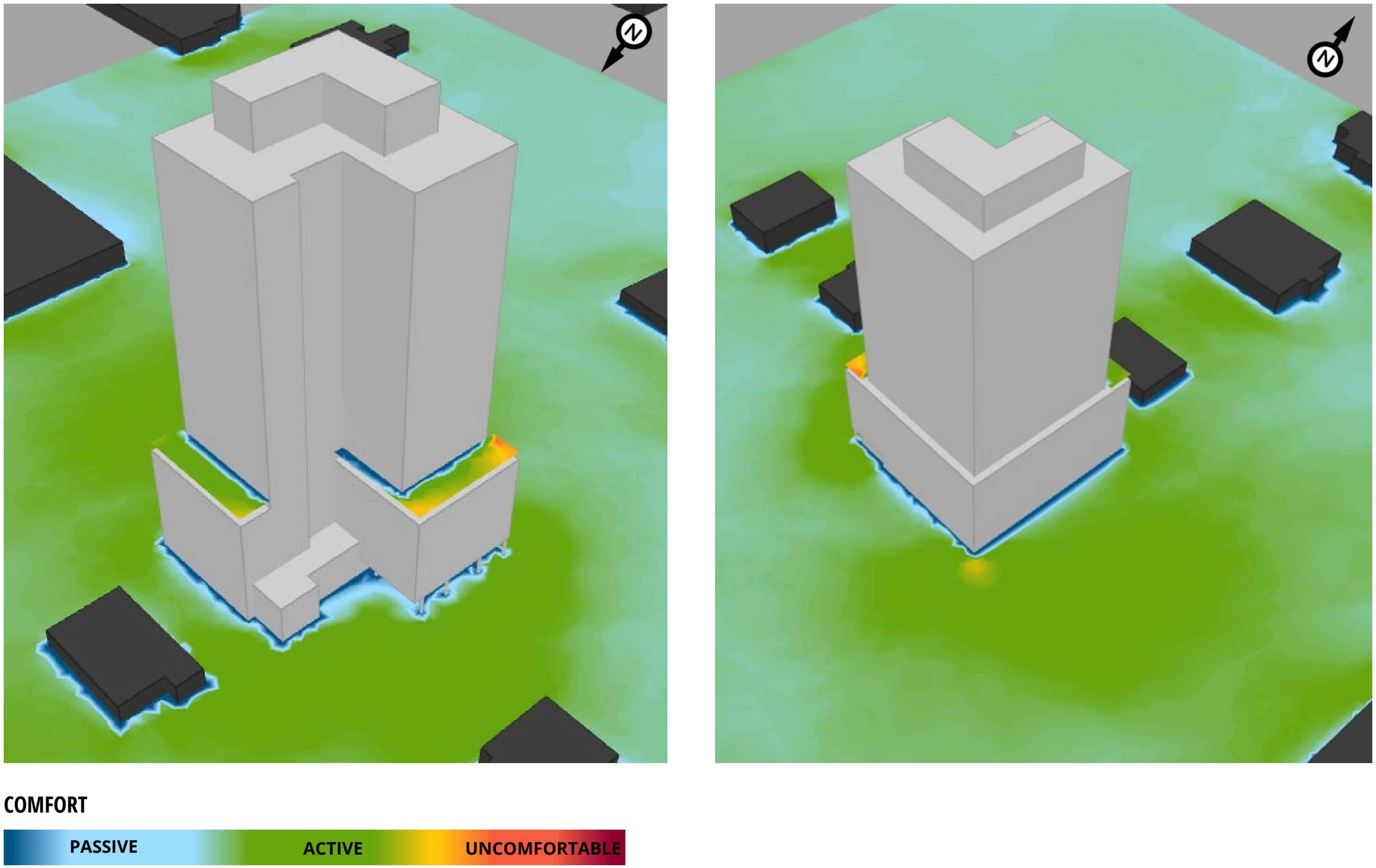
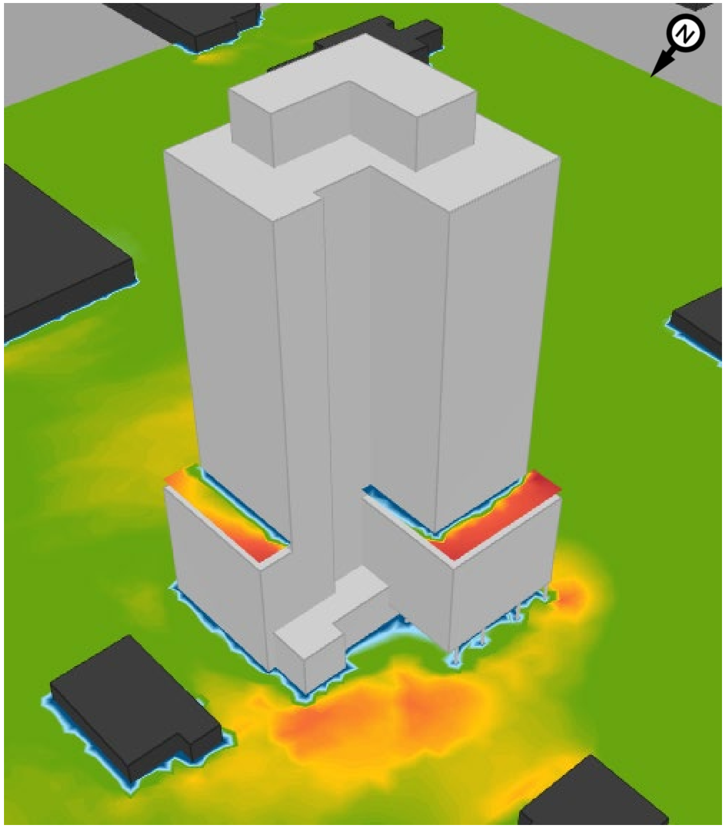
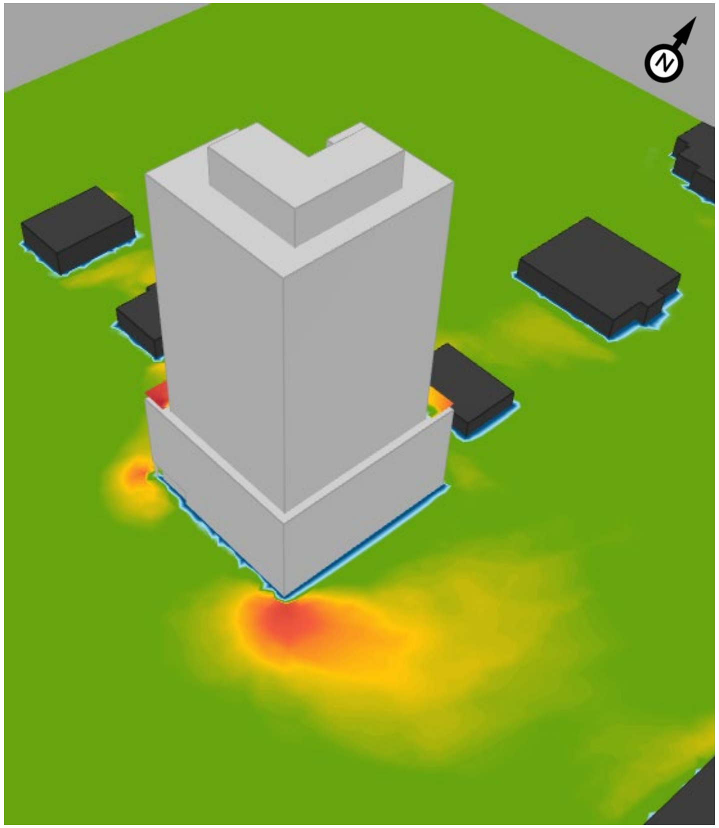


Image 8a: Predicted Wind Conditions – Summer

5.4 Proposed Scenario: Wind Conditions





COMFORT

PASSIVE ACTIVE UNCOMFORTABLE

Image 8b: Predicted Wind Conditions – Winter

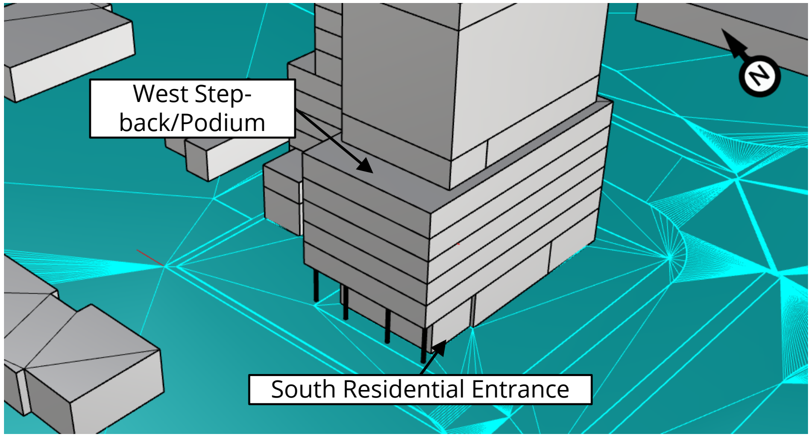
5. RESULTS AND DISCUSSION

5.4 Proposed Scenario: Wind Conditions

5.4.1 Building Entrances

The residential entrances are located along the south and north façades of the west podium (Image 9). The location of these entrances, under an overhang, is positive as they are protected by the building massing from the vertical component of downwashing winds. However, these entrances are close to the corners of the building and, thus, they will be exposed to the horizontal component of accelerated flow. Therefore, wind speeds comfortable for strolling or walking are expected near the entrances throughout the year. These wind speeds are not appropriate near entrances.

It is worth noting that the residential entrances are equipped with vestibules, which provide an area where pedestrians can take shelter from occasional high wind speeds. If feasible, we recommend re-locating the residential entrances away from the windy corners (i.e., switch north residential entrance with the mail entrance – Image 3). To Lower wind speeds near the entrances at their current locations, it is recommended to recess the entrances from the main façades to create sheltered doorway, if possible. Alternatively, wind screens can be placed on the west side of the entrances to re-direct/ diffuse the accelerated winds near the corners. The wind screen should be at least 2 m tall and no more than 30% open for maximum benefit. Examples of the suggested wind control measures are shown in Image 10 for reference.



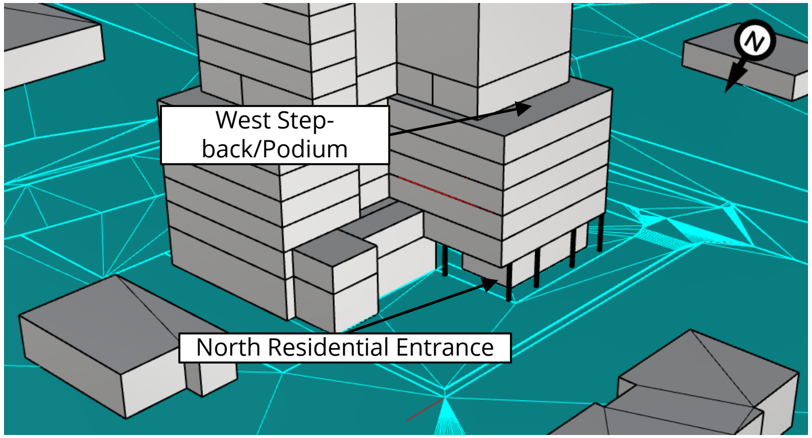


Image 9: Main Entrances – Location and Design

5. RESULTS AND DISCUSSION

Image 10: Examples of Wind Control Strategies Applicable to Entrances

5.4.2 Public Sidewalks and Surrounding Areas

With the addition of the proposed building, higher wind activity is expected on and around the site, including sidewalks/walkways, mainly due to the building height relative to the surroundings. Downwashing of the prevailing southwesterly and northeasterly winds from the south, west and east façades of the building and the consequent corner acceleration flows are expected to cause windy conditions near the exposed corners of the building.

In the summer, wind speeds comfortable for standing or strolling are expected at most areas on and around the building, with higher wind speeds comfortable for walking around the southeast corner of the building (Image 8a). These wind conditions are appropriate for the intended use of sidewalks/ walkways.

In the winter, due to the seasonal wind climate in the area, higher wind activity is expected throughout the project site (Image 8b), with wind conditions comfortable for strolling or walking at most pedestrian areas. Uncomfortable wind conditions and wind speeds that may exceed the pedestrian wind safety criterion may occur around the southeast corner of the building. These wind conditions are not appropriate for any pedestrian usage. Wind tunnel testing is suggested for a later design stage to quantify and assess the wind comfort and safety conditions on and around the project site.

The large tower step-backs along the north and west sides of the building are positive design features for wind control at grade level and are expected to moderate the impact of strong prevailing winds in the northwest side of the building. The design team are encouraged to consider large-scale wind mitigation measures such as larger step-backs along the east and south sides of the building or a corner articulation at the southeast side, if feasible, to improve wind conditions around the southeast corner of the building. Such measures will be the most effective in moderating the building/wind interactions and reducing the wind impact at grade through deflecting the downwashing winds and disorganizing the accelerating flows.

The use of large canopies along the east and south building façades and wrapping around the southeast corner can also help deflect the downwashing winds and moderate wind speeds at grade level. Horizontal features like canopies should be installed at maximum 1-storey height to be the most effective. Furthermore, any form of vertical barrier (wind screens and landscaping) near the southeast corner of the building would also help re-directing/diffusing the horizontal component of winds. These vertical barriers should be at least 2 m tall and no more than 30% open for maximum benefit. Examples are shown in Image 11 for reference.

5. RESULTS AND DISCUSSION

Image 11: Examples of Wind Control Strategies Applicable to the Southeast Side of the Building

5.4.3 Outdoor Amenity Spaces

We understand that outdoor amenity spaces are proposed on the ground in the north side of the building as well as on west and north sides of Level 7 (Image 3).

The location of the ground outdoor amenity space is positive since it is protected by the building massing from the strong southwesterly winds. Additionally, the north side of the building has a large step-back, which would help re-directing the downwashing due to northeast winds away from the ground level in that side. The ground floor plan (Image 3) also shows large trees planned throughout the amenity space. Therefore, wind conditions comfortable for sitting or standing are expected at most areas in the ground floor outdoor amenity space during the summer, when the area would be typically in use. Slightly higher wind speeds comfortable for strolling are expected at the east and west ends of the amenity space.

Although the large north and west step-backs on Level 7 are useful design features towards reducing wind speeds at ground level, the downwashing from prevailing winds is expected to land on those step-backs, causing a high wind activity on them. Wind conditions comfortable for strolling or walking are expected at the large north amenity space on Level 7, while wind speeds comfortable for walking are expected at the large west amenity space, with potentially uncomfortable wind conditions at the exposed corners. Lower wind speeds comfortable for sitting or standing are expected in the smaller amenity spaces at the inner sides of the northwest corner of the building.

In the winter, higher wind activity and conditions that are not suitable for passive uses are expected in the outdoor amenity spaces, especially at the above-grade spaces. Nonetheless, this may not be of concern as these areas are not expected to be used for passive activities in the cold months.

Note that these wind predictions are based on the 3D model received, which shows no railing or any landscaping/hardscaping features on the terraces. To lower wind speeds at the east and west ends of the ground floor outdoor amenity space, the design team may consider landscaping features at both ends of the amenity space, close to the building corners, as well as shifting any seating areas away from the east and west ends.

To improve wind conditions at the Level 7 outdoor amenity spaces, we recommend incorporating tall railing, at least 2 m, to provide sheltering from the horizontal winds coming from northeast and southwest directions. Additionally, landscaping/hardscaping features in the form of planters, partitions and screens around the designated seating areas are recommended to create sheltered zones for passive usage. Overhead measures like trellises and umbrellas on seating areas maybe also be considered to help deflect/diffuse downwashing winds. Examples are shown in Image 12 for reference.

5. RESULTS AND DISCUSSION

Image 12: Design Strategies for Wind Control Applicable to Outdoor Amenity Spaces

6. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed project at 1600 Upper James Street in Hamilton, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar buildings, and screening-level modelling of the proposed building.

Our findings are summarized as follows:

- The existing wind conditions are appropriate for the intended use and are expected to meet the pedestrian wind safety criterion.
- The proposed building will be significantly taller than buildings in the surrounding area, and therefore is expected to cause an increase in wind speeds at localized areas around it.
- The building design incorporated several wind-responsive features, such as corner articulations, large step-backs, and massing overhang, which will moderate the potential wind impacts on the surroundings.
- Wind conditions at most areas around the site, including sidewalks/walkways, are expected to be appropriate for the intended use throughout the year. Uncomfortable wind conditions are, however, expected around the southeast corner of the building during the winter season. The pedestrian wind safety criterion may also be exceeded around the southeast corner of the building.
- Higher than desired wind speeds are predicted at the residential entrances throughout the year.
- Wind conditions on the outdoor amenity space at grade are generally appropriate for the intended use in the summer. Higher wind activity and windy conditions for passive uses are expected on the exposed Level 7 outdoor amenity spaces.
- Wind control measures have been discussed for the entrances, southeast corner of the building, as well as the outdoor amenity spaces, in order to achieve appropriate wind conditions.
- Wind-tunnel testing is suggested for a later design stage to quantify and assess the wind comfort and safety conditions on and around the project site and to confirm the effectiveness of any mitigation.

7. STATEMENT OF LIMITATIONS

Design Assumptions

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI on July 10, 2023, 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)
1600 Upper James Street - 3D massing	DWG	07/10/2023
1600 Upper James Street_dA2.03 Level 01 & 02	PDF	07/10/2023
1600 Upper James Street_dA2.05 Level 07 & 08-21	PDF	07/10/2023

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.

Limitations

This report was prepared by Rowan Williams Davies & Irwin Inc. for LJM Developments ("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.