REPORT
BRANT + GHENT MASTERPLAN
BURLINGTON, ONTARIO

PEDESTRIAN WIND ASSESSMENT

RWDI PROJECT #2004219
MAY 14, 2021

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Molinaro Group to conduct a qualitative assessment of the pedestrian wind conditions expected around the proposed Brant + Ghent Masterplan in Burlington, Ontario (Image 1).

The project site is located at the intersection of Brant Street and Ghent Avenue (Image 1). It is currently occupied by low-rise buildings, a parking lot and a vacant land. The surrounding buildings are typically low in all directions, except three relatively tall buildings along Ghent Avenue to the southwest. Tall buildings also exist to the distant southeast and south near Lake Ontario.

The proposed master plan consists of three phases (see Images 2 and 3 on the next page):

- Phase 1: a 25-storey tower and a 14-storey tower with a 10-storey link and 3-storey podium
- Phase 2: a 25-storey tower with a 3-storey podium along Brant Street and stepping down from 10 storeys to 3 storeys along Ghent Avenue; and,
- Phase 3: an 8-storey building with a 3-storey podium.

Pedestrian areas of interest include public sidewalks and walkways, building entrances and amenity spaces at and above grade.

Image 1: Aerial view of the existing site and surroundings (credit: Google Earth)

1. INTRODUCTION

Image 2: Site plan

Image 3: South view of the project

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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 qualitative screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

RWDI's wind assessment is based on the following:

- Design drawings received by RWDI on February 19, 2021, and April 30, 2021;
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- A review of the long-term meteorological data for the Burlington area;
- Burlington pedestrian wind criteria;
- Wind-tunnel studies and desktop assessments undertaken by RWDI for projects in Burlington and around the world; and,
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3].

Note that other wind issues, such as those related to cladding and structural wind loads, door operability, snow loading, etc., are not considered in the scope of this assessment.

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 recorded between 1990 and 2019 were used as reference for wind conditions around the current project. 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 (regardless of speeds), winds are frequent from the southwest and northeast quadrants for both seasons, as indicated by the wind roses in Image 4.

Strong winds of a mean speed greater than 30 km/h measured at the airport at an anemometer height of 10 m occur more often in the winter than in the summer (red and yellow bands in Image 4). They are also from the southwest and northeast quadrants.

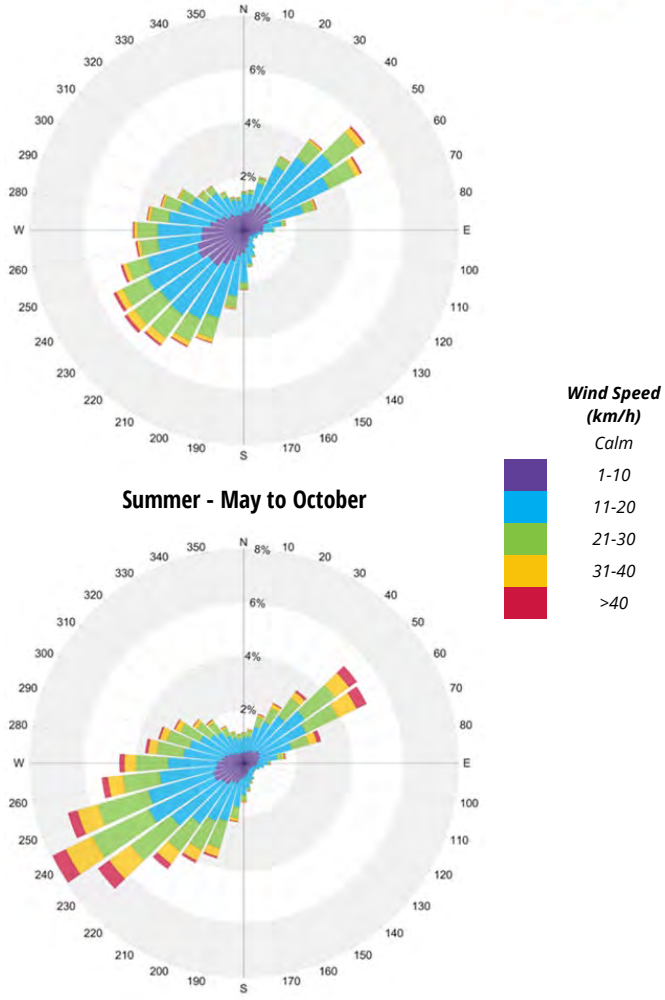


Image 4: Directional distribution of winds approaching Hamilton International Airport (1990–2019)

4. WIND CRITERIA

The Burlington pedestrian wind criteria, developed in March 2020, are specified in the Guidelines and Terms of Reference, "Pedestrian Level Wind Study". The table to the right defines the criteria for both wind comfort and safety.

These criteria for wind forces represent average wind tolerance. They are sometimes subjective as 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.

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 and open terrain).

For the current development, wind speeds comfortable for fast walking or leisurely walking are appropriate for sidewalks and walkways; lower wind speeds comfortable for standing are required for main entrances where pedestrians may linger, and calm wind speeds suitable for sitting are desired in areas where passive activities are anticipated, such as the above-grade terraces, especially during the summer when these areas are typically in use.

Comfort Category	GEM Speed (km/h)	Description
Sitting	≤ 10	Calm or light breezes • Appropriate for dedicated seating areas such as cafes, patios, and outdoor amenity areas
Standing	≤ 14	Gentle breezes • Appropriate for main building entrances, bus stops, and other places where pedestrians may linger
Leisurely Walking	≤ 17	Moderate winds • Appropriate for shopping and strolling along retail streets and parks
Fast Walking	≤ 20	Relative higher speed winds • Appropriate for areas where pedestrians are walking, running, or cycling without lingering
Uncomfortable	> 20	Strong winds • Inappropriate due to nuisance for all pedestrian activities • Wind mitigation measures required

Notes:

(1) GEM is defined as the maximum mean wind speed or gust speed divided by 1.85 (whichever is larger). Gust speed can be directly measured in a wind tunnel or represented by mean wind speed + 3*RMS (Root Mean Square) wind speed.

(2) GEM speeds listed above are based on a seasonal exceedance of 20% of the time between 06:00 and 23:00. The criterion has been met if the wind speeds occur at least four out of five days.

Safety Criterion	Gust Speed (km/h)	Description
Exceeded	> 90	• Excessive gust speeds • Adverse effect on pedestrian's balance and footing • Wind mitigation is required

Notes:

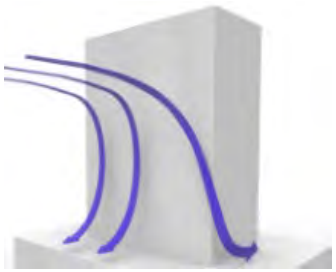
(1) Based on an annual exceedance of 9 hours or 0.1% of the time for 24 hours a day.

(2) Gust speed can be directly measured in a wind tunnel or represented by mean wind speed + 3*RMS wind speed.

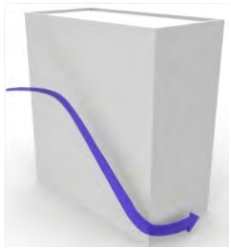
5. RESULTS AND DISCUSSION

5.1 Wind Flow around Buildings

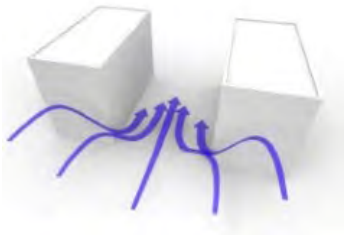
Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Downwashing, Image 5a). These winds subsequently move around exposed building corners (Corner Acceleration, 5b), and along the gap between buildings (Channelling Effect, 5c), causing increased wind activity at grade. If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and uncomfortable conditions.



a) Downwashing Flow



b) Corner Acceleration



c) Channelling Effect

Image 5: Generalized wind flows

5.2 Existing Conditions

The existing or demolished buildings on the project site are low and surrounded by similar or taller buildings in all directions. As such, wind conditions on the sidewalks around the site are considered to be comfortable for sitting or standing in the summer and for standing or leisurely walking in the winter.

Although the existing buildings along Ghent Avenue are relatively tall, they have their longer axis aligned with the predominant southwest and northeast winds. Wind conditions exceeding the safety criterion are not expected at the intersection and in the surrounding areas.

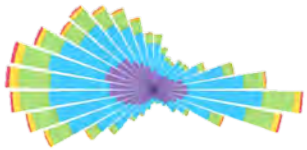
5.3 Proposed Wind Conditions

As shown in Image 4, the prevailing winds are from the southwest and northeast directions for both the summer and winter seasons. Two proposed towers are 25 storeys and others are 14 and 7 storeys, which are taller than the existing surroundings in the prevailing wind directions. They will deflect winds down to the grade level, causing increased wind activity around tower corners and along the sidewalks (Image 5).

The resultant wind conditions are predicted in Images 6a and 6b for the summer and winter seasons, respectively, together with the corresponding wind roses. The following sections provide a detailed discussion of the potential wind conditions around the project.

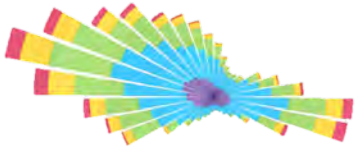
5. RESULTS AND DISCUSSION

5.3 Proposed Wind Conditions



COMFORT CATEGORIES

- Sitting / Standing
- Leisurely Walking / Fast Walking
- Potentially Uncomfortable or Unsafe



Summer - May to October

Winter - November to April

Image 6a: Predicted wind conditions - Summer

Image 6b: Predicted wind conditions - Winter

5.3.1 Phase 1

There are several positive features for wind control with the Phase 1 masterplan. The proposed 3-storey podium around both buildings is expected to reduce the direct impact of winds downwashing off the buildings on the ground level. The 14-storey building is located west to the 25-storey tower, reducing the wind exposure of the project to the prevailing southwest winds. The main entrances (Locations A1 and A2 in Image 7) are located in recessed and protected areas, and designed with vestibules. The proposed towers also protect the above-grade amenity spaces at Levels 4 and 11 for one or both predominant wind directions (B1 and B2, respectively).

Suitable wind conditions are expected for the main entrances and the POPS areas away from building corners (Images 6a and 6b). Wind speeds on the podium amenity spaces are predicted to be moderate, but higher than desired for passive activities in the summer (Image 6), due to winds being deflected down by the 25-storey tower and channelled between the proposed buildings. High wind activity on podium terraces during the winter (Image 6b) is not a concern due to reduced usage during cold months.

In addition to the proposed trellis, other wind control measures for the podium amenity spaces may consist of tall guardrails along the perimeters and localized elements around any seating areas, including screens and landscaping - see photo examples in Image 8a on the next page.

Suitable wind conditions are also expected on all sidewalks and walkways during the summer, and on most pedestrian areas during the winter (Images 6a and 6b). The exposed tower corners (C1, C2 and C3 in Image 7) are exceptions, where wind conditions may become uncomfortable or potentially unsafe during the winter. Wind tunnel testing is recommended at a later design stage to quantify these wind conditions and to develop and verify the effectiveness of wind control solutions.

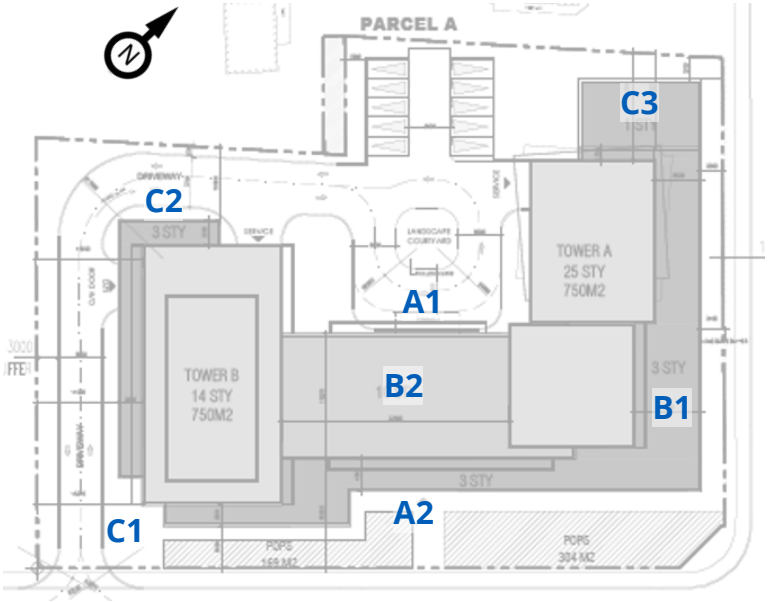


Image 7: Roof plan of Phase 1

5. RESULTS AND DISCUSSION

5.3.1 Phase 1 (continued)

The potential wind control measures for these windy areas may range from architectural changes to local landscaping elements. Examples of various types of mitigation options are provided in Image 8b. RWDI will work with the design team to determine the most suitable options prior to verification in the wind tunnel.

Image 8a: Wind control features for podium amenity

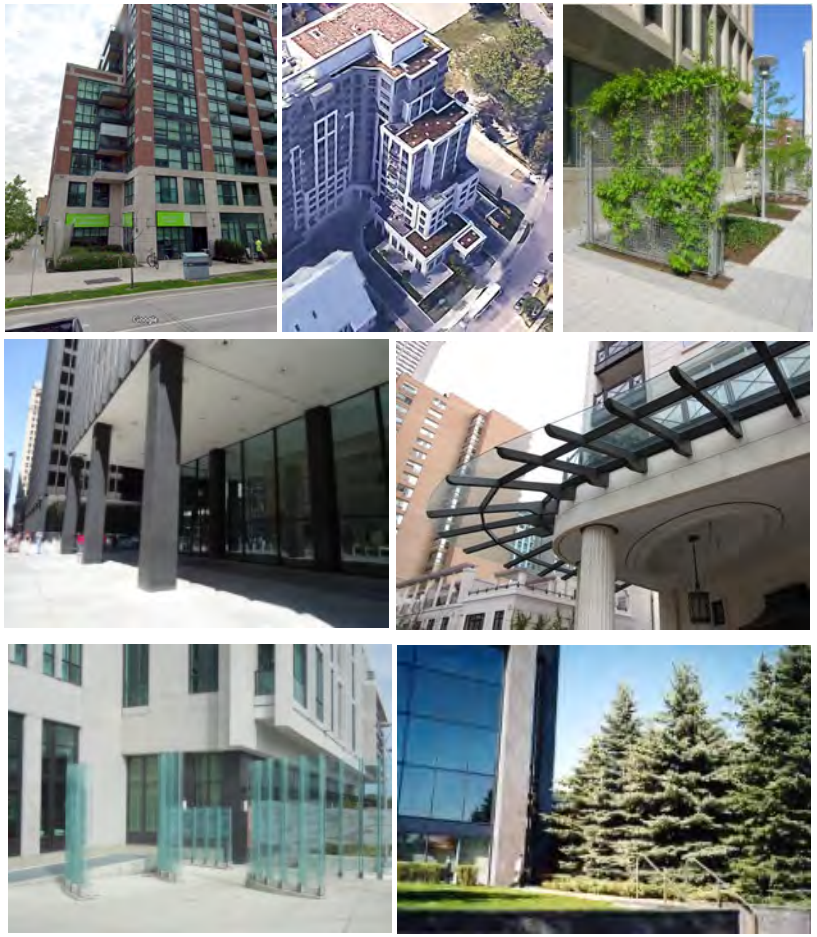


Image 8b: Wind control measures for building corners and sidewalks

5.3.2 Phase 2

The 25-storey tower of Phase 2 will be largely sheltered by the Phase 1 towers from the southwest winds. The 3-storey podium is positive to reduce downwashing winds and the stepped east wing is also positive for reducing the impact of northeast winds.

Similar to Phase 1, suitable wind conditions are expected at the protected main entrance D1 in Image 9 throughout the year, while wind speeds at the intersection entrance D2 are likely higher than desired in the winter. If feasible, a wind screen or planter may be considered on the west side of the entrance D2 for wind control - see examples in Image 10.

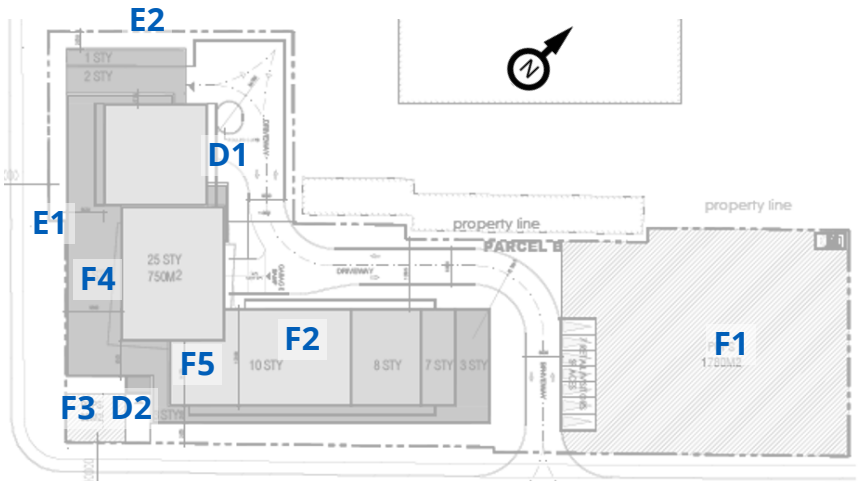


Image 9: Roof plan of Phase 2

While wind conditions on most sidewalks and walkways are predicted to be suitable for both the summer and winter seasons, localized areas of uncomfortable or unsafe winds are expected west and north of the 25-storey tower (E1 and E2 in Image 9), due to winds being deflected down by the towers of Phase 1 and Phase 2. Similar wind control solutions as in Phase 1 can be considered (Section 5.3.1 and Image 8b), and wind tunnel testing is recommended at a later design stage.

Low wind speeds comfortable for sitting or standing are expected at the large POPS to the east of the Phase 2 building (F1 in Image 9) and at the east portion of the amenity at Level 11 (F2) in the summer. However, higher wind speeds comfortable for strolling or walking are expected at the POPS at the intersection (F3), on the amenity at Level 4 (F4) and at the west end of Level 11 amenity (F5). Winter wind conditions in these areas may become uncomfortable or unsafe. Typical wind control measures may include tall guardrails, wind screens, trellises and landscaping – see Image 8a for examples.

Image 10: Wind control concepts for main entrances

5.3.3 Phase 3

The proposed building in Phase 3 is 8 storeys in height and has several positive features for wind control, including the recessed main entrance (G1 in Image 11), re-entrant northwest corner at the intersection (G2) and 3-storey steps on both the east and west sides.

The proposed Phase 3 building will not negatively affect the wind conditions around Phases 1 and 2 and suitable wind conditions are predicted on and around the Phase 3 building, including entrances and sidewalks throughout the year and the POPS at the intersection (H1), terraces on the podium (H2) and the amenity space on the roof (H3) during the summer months.

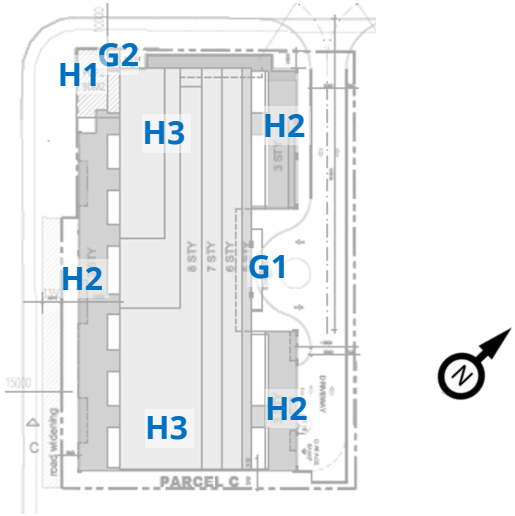


Image 11: Roof plan of Phase 3

6. SUMMARY

RWDI was retained by Molinaro Group to provide an assessment of the potential pedestrian wind conditions on and around the proposed Brant + Ghent Masterplan in Burlington, Ontario. Our assessment was based on the Burlington Guidelines and Terms of Reference for Pedestrian Level Wind Study, 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.

Our findings are summarized as follows:

- The proposed masterplan includes several positive design features such as low podiums around the proposed towers, and favorable locations for most main entrances and amenity spaces.

- Suitable wind conditions are expected in the summer for all pedestrian areas, including all main entrances and sidewalks, as well as most amenity spaces.

- During the winter, elevated wind speeds around tower corners may become uncomfortable or potentially unsafe. Higher-than-desired wind speeds are also predicted at the Phase 2 tower entrance at the intersection during the winter, as well as at the exposed terraces on the podiums of Phases 1 and 2 during the summer. With the proper mitigation in the form of soft and hard landscaping wind conditions can be improved.

- Conceptual wind control measures are provided in the report and will be reviewed with the design team and validated through wind tunnel testing at a later design stage to quantify the level and frequency of high wind activity, and to develop and refine wind control solutions.

7. APPLICABILITY OF RESULTS

The assessment presented in this report is for the proposed Brant + Ghent Masterplan based on the information received by RWDI on February 19, 2021, and April 30, 2021, as listed in the table below. In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.

File Name	File Type	Date Received (mm/dd/yyyy)
1398.16.Brant+Ghent.New option	DWG	02/19/2021
1398.16.X.ELEVATION	DWG	02/19/2021
Brant & Ghent - overall concept feb.19.2021	SKP	02/19/2021
1398.16.Brant+Ghent Plans	DWG	04/30/2021
1398.16.Brant+Ghent_apr.30.2021	PDF	04/30/2021