February 20, 2019

Jadco Group Construction
345 Boulevard Samson
Laval, QC  H7X 2Z7

Attn: Simon Labelle, Project Manager
slabelle@jadcogroup.com

Dear Mr. Labelle:

Re: Pedestrian Level Wind Study Addendum
180 Metcalfe Street, Ottawa, ON
GWE File No.: 18-115-PLW Addendum Dec 2018

Following our submission of a detailed pedestrian level wind (PLW) study using the Computational Fluid Dynamics (CFD) technique for a Site Plan Control Application (SPA) for the proposed mixed-use development located at 180 Metcalfe Street in Ottawa (ref. Gradient Wind report #18-115-PLW R1, dated December 21, 2018), this brief letter addresses a comment from the City of Ottawa regarding the method in which the Atmospheric Boundary Layer (ABL) has been considered in the above noted study (ref. City of Ottawa File Number D07-12-18-0125, dated February 5, 2019, Item Number 15).

The ABL is defined by the velocity and turbulence profiles according to industry standard practices. As outlined in Appendix A in the main study, the mean wind profile can be represented, to a good approximation, by a power law relation, Equation (1), giving height above ground versus wind speed.

$$U = U_g \left( \frac{Z}{Z_g} \right)^{\alpha} \qquad \text{Equation (1)}$$

For the model, $U_g$ = gradient wind speed, and is set to 6.5 metres per second (m/s), which approximately corresponds to the 60% wind speed for Ottawa based on historical climate data and statistical analyses. When the results are normalized by this velocity, they are relatively insensitive to the selection of gradient wind speed.

$Z_g$ = gradient height and is set to 540 m. The selection of gradient height is relatively unimportant, so long as it exceeds the building heights surrounding the subject site. The value has been selected to correspond to our physical wind tunnel reference value.

α = the power law exponent and is determined based on upstream exposure of the far-field surroundings (i.e., the area that it not captured within the simulation model). Table 1 presents the values of α used in this study, while Table 2 presents several reference values of α. When the upstream exposure of the far-field surroundings is a mixture of multiple types of terrain, the α values are a weighted average with terrain that is closer to the subject site given greater weight.

**TABLE 1: UPSTREAM EXPOSURE (ALPHA VALUE) VS TRUE WIND DIRECTION**

| Wind Direction (° True) [1] | Alpha (α) Value |
|---|---|
| 0 | 0.26 |
| 49 | 0.26 |
| 74 | 0.25 |
| 103 | 0.25 |
| 167 | 0.25 |
| 197 | 0.25 |
| 217 | 0.25 |
| 237 | 0.25 |
| 262 | 0.29 |
| 282 | 0.28 |
| 301 | 0.29 |
| 324 | 0.27 |

Note:

1. Wind directions are selected such that each simulation represents a range of wind directions with equal probability to the other simulations.

**TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)**

| Upstream Exposure Type | α |
|---|---|
| Open Water | 0.14-0.15 |
| Fields | 0.16-0.19 |
| Light Suburban | 0.21-0.24 |
| Heavy Suburban | 0.24-0.27 |
| Light Urban | 0.28-0.30 |
| Heavy Urban | 0.31-0.33 |

The turbulence model in the CFD simulations is a two-equation model, and thus the ABL turbulence profile requires that two parameters be defined at the inlet of the domain. The turbulence profile is defined by the intensity, Equation (2), and the length scale, Equation (3).

$$I = 0.1\left(\frac{\max(Z, 10m)}{30m}\right)^{\alpha-0.05} \quad \text{Equation (2)}$$

$$L_t = 100m\sqrt{\frac{\max(Z, 30m)}{30m}} \quad \text{Equation (3)}$$

Where I is the turbulence intensity, $L_t$ is the turbulence length scale, Z is the height above ground, and α is the power law exponent used for the velocity profile.

We trust that the above explanation satisfies the City of Ottawa File Number D07-12-18-0125, Item Number 15. Please contact the undersigned with any questions or comments.

Sincerely,

***Gradient Wind Engineering Inc.***

Steven Hall, M.A.Sc., P.Eng.
Wind Engineer

Justin Ferraro
Principal