Estimation of Urban Wind Energy - Equiterre Building Case in Montreal

Ayman A. Al-Quraan[1], Ted. Stathopoulos [2] and P. Pillay [3]

[1] (Electrical & Computer Engineering, Concordia university, 1455 de Maisonneuve Blvd. W., Canada)
e-mail: ay_alqur@encs.concordia.ca

[2](Building Engineering, Concordia university, 1455 de Maisonneuve Blvd. W., Canada)
e-mail: statho@bcee.concordia.ca

[3](Electrical & Computer Engineering, Concordia university, 1455 de Maisonneuve Blvd. W., Canada)
e-mail: pillay@encs.concordia.ca

Keywords: Urban Wind Turbine, Urban Energy, Wind Tunnel, Wind Speed Estimation

ABSTRACT

Urban energy generation such as that produced by small scale wind turbines installed on or around buildings can be defined as micro-generation. In the last few decades, there is a growing interest in the use of wind power in buildings. Given that the wind speed varies significantly at different locations over buildings' roofs in the urban environment, the generated power, which is a function of the cube of the wind speed, will be very sensitive to the location of wind turbine above the roof.

The prediction of the wind speed in the built environment is difficult, due to the large roughness and the frictional effects, which reduce the wind speed close to the ground. The most dependable method for the wind assessment in the urban environment is to directly measure the wind speed, ideally at the position (location and height) of the proposed wind turbine. However, measuring the wind speed at a site is both time consuming and expensive i.e. normally not appropriate for the early stages of wind power development.

However, there are several methods available for the initial assessment of wind resource in the urban area, with varying degrees of resolution and accuracy. In order of increasing accuracy, such methods include wind atlases, wind tunnel modelling and the direct wind recourse measurement, if our interest lies on existing buildings. A variety of wind atlases are available at continental and national level. For instance, the Canadian wind energy atlas – http://www.windatlas.ca – covers a wide area but its low resolution can only provide a general picture of the wind resource, let alone that wind atlases cannot take into account local variations and their effect in the wind distribution.

On a more refined scale, wind speeds can be implemented using wind tunnel models. These models must be primed with data at a known location, usually local meteorological stations or airports. Wind tunnel tests may give a more accurate estimate of the wind regime without actually undertaking field wind measurements. The paper discusses the methodology of estimating wind speeds for urban power generation. A case study for one building in Montreal, the Equiterre building, will be discussed in detail. Field wind measurements from an anemometer on Equiterre building are compared with Trudeau airport corrected data. Wind tunnel test results provide the expected wind speed over this building and are compared with the field measurements. The correlation and the discrepancy of these comparisons are discussed in the paper.