Profiles of mean wind speeds and turbulence measured in strong wind conditions over an urban area

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To design tall buildings in urban areas, wind engineers need to calculate the potential wind loading on the structure. This necessitates the need for an accurate representation of the vertical profile of the wind velocity and turbulence intensity in strong wind conditions. The current UK wind loading code applies an extended version of the Deaves and Harris model to represent the wind profile throughout the entire boundary layer, (Cook, 1997). While a number of studies have used observations at various elevations to estimate the characteristics of the boundary layer over open or suburban terrain, wind speed measurements over urban areas are currently very limited (Tieleman, 2008). Consequently there has been little validation of the approach outlined in the UK wind loading code for heterogeneous urban terrain.

As part of the ACTUAL project, data have been collected by a pulsed Doppler lidar (Halo Photonics) in central London since July 2010, either at Westminster City Council's building on Marylebone Road or the Strand campus of Kings College London (ACTUAL, 2011). This study compares the wind speed profiles derived from Doppler lidar measurements during strong wind conditions (using a Doppler Beam Swinging method), with the predictions of the Deaves and Harris model, as well as two other models; the empirical power-law and the theoretical log-law.

In addition, using the expressions derived by Macdonald et al. (1998) the magnitude of roughness length and displacement height has been estimated on a 1 km resolution based on a database of the frontal and plan area ratios of the buildings in Greater London, (Evans, 2009). Comparisons have then been made with the simple surface classification approximation applied in the wind loading code. The results presented will show whether a more detailed assessment of the urban surface provides an improved representation of the wind profile.

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