ABSTRACT:

It is difficult to describe the flow characteristics within and above urban canopies using only geometrical parameters such as plan area index (? p) and frontal area index (? f) because urban surfaces comprise buildings with random layouts, shapes, and heights. Furthermore, two types of 'randomness' are associated with the geometry of building arrays: the randomness of element heights (vertical) and that of the rotation angles of each block (horizontal). In this study, wind-tunnel experiments were conducted on seven types of urban building arrays with various roughness packing densities to measure the bulk drag coefficient (C d) and mean wind profile; aerodynamic parameters such as roughness length (z o) and displacement height (d) were also estimated. The results are compared with previous results from regular arrays having neither 'vertical' nor 'horizontal' randomness. In vertical random arrays, the plot of C d and z o versus ? f exhibited a monotonic increase, and z o increased by a factor of almost two for ? f = 48-70%. C d was strongly influenced by the standard deviation of the height of blocks (s) when ? p = 17%, whereas C d was independent of s when ? p = 7%. In the case of horizontal random arrays, the plot of the estimated C d against ? f showed a peak. The effect of both vertical and horizontal randomness of the layout on aerodynamic parameters can be explained by the structure of the vortices around the blocks; the aspect ratio of the block is an appropriate index for the estimation of such features.