FLOW AND DISPERSION IN THE PRESENCE OF SURFACE-MOUNTED CUBES

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The wind ground layer structure is an important factor influencing the climate and health in built-up areas, determining the strength and natural ventilation of constructions and affecting the dispersion processes. The propagation of pollutants around wind engineering structures, governed by convection and diffusion mechanism and depends strongly on the local velocity field (Moryn-Kucharczyk et al., 2007). To understand the phenomena related to the forming of concentration fields it is necessary to recognize the local features of the flow in built-up areas with the special emphasize for the mean velocity direction, random fluctuations and periodical oscillations accompanying an vortex generation in bodies neighborhood.

The paper presents and discusses the results of the complex research program aimed at understanding a character of the flow field in vicinity of bluff-bodies immersed in a boundary layer, as an important element of unsteady phenomena generated in the ground-level zone and forming processes of pollutant dispersion. The experimental modeling of the flow around the body arrangement and the mean concentration profiles of tracer gas (CO\textsubscript{2}) was supported and extended with numerical simulations performed with the use of the commercial CFD code (FLUENT). During experimental and numerical model testing of environmental aerodynamics, actual shapes of ground object are typically replaced with their simplified versions.

The analysis has been performed for the simple example of inline arrangement of two surface-mounted square cylinders arranged in tandem $H_1/H_2 = 0.6$, for different location of...
emission source (see Fig. 1). The source of emission of carbon dioxide used as a tracer gas during the investigations was located before the windward object.

Analysis of gas pollutants dispersion process requires in-depth identification of the structure of flow around the buildings. The flow structure around three-dimensional bluff-body located on the surface with formed boundary layer is characterized by a high level of complexity (Gnatowska et al., 2009). The case under consideration in this work concerns tandem arrangement which is characterized by \( H_1/H_2 \) parameter, which is conducive to occurrence of so-called “downwash” effect \( H_1/H_2=0.6 \). This effect consists in washing of front side of the leeward object with large air masses, which results in strong air circulation in the area between objects, which determines flow structure between them.

The observed modifying impact of interaction between the objects in tandem arrangement is reflected in the results of measurements of concentration of the tracer gas emitted in their environment (Gnatowska, 2011). The aim of this work was to determine the impact of objects configuration, their degree of "immersion" in the boundary layer and location of emission source for the spread of the tracer gas emitted in the vicinity of two rectangular blocks in tandem arrangement. Such studies may contribute to the better understanding of physical processes and provide necessary information for the development of numerical modeling.

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References
