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THE ANALYSIS OF AIRFLOW AROUND BUILDINGS INVARIOUS CONFIGURATIONS OF ARRANGEMENT AND HEIGHT

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Recently, airflow around buildings has become a problem which is of more concern to both architects and investors. The wind-tunnel studies are one of the ways of eliminating the negative effects of wind at the early design stage. However, this method is time-consuming and expensive. The numerical simulation can be a starting-point for these studies. It allows for investigation of many different cases of airflow (changes of the wind direction and velocity or geometry) and, as a result, finding the optimal position of the buildings in the relation to other buildings without bearing extra costs. Then only the optimal position can be studied in the wind tunnel.
The paper presents the results of the numerical calculations of airflow around two buildings in different configurations of position and height.

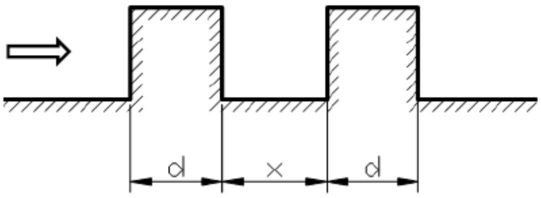


Fig. 1 Visual picture – case I

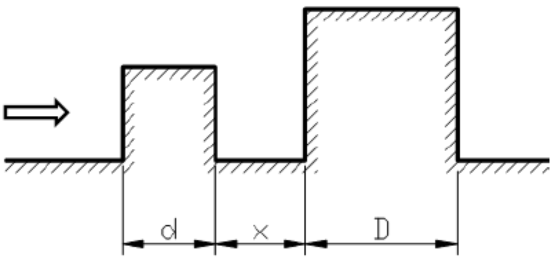


Fig. 2 Visual picture – case II

The Ansysy – Fluent package of programs were used in this work. The buildings were situated along the flow direction and their scale was chosen to enable a comparison of the numerical and wind-tunnel results. The study is concerned mostly with the analysis of parameters which are essential in the building industry, such as pressure and velocity fields. The changes in the flow as the buildings were moved apart were observed and then on the basis of these studies the border distance which would ensure the proper ventilation zone between the buildings was determined.
The simulations were made for two different Reynolds numbers ($\mathrm{Re}_1 = 4.1 \cdot 10^4$ and $\mathrm{Re}_2 = 8.2 \cdot 10^4$) and for various distances between the cubes (which represent buildings). Their orientation was normal to the flow. The model $K-\varepsilon$ realizable of turbulence together with a basic model of boundary layer – Standard Wall Treatment were used.
The comparison of the numerical and the wind-tunnel results was the initial stage of the study. The profile of velocity identical with the one in the experiment was used on the inlet.
The highest similarity in the distribution of pressure was obtained on the windward and leeward walls of the first and second buildings. The differences increased on the sides and the

roof, which were in the most turbulent zones. The differences may result from the simplifications used in the $K-\varepsilon$ models and also from difficulties in making accurate measurements in such conditions.

Fig. 3 Distribution of the pressure on the windward (building I) – numerical results

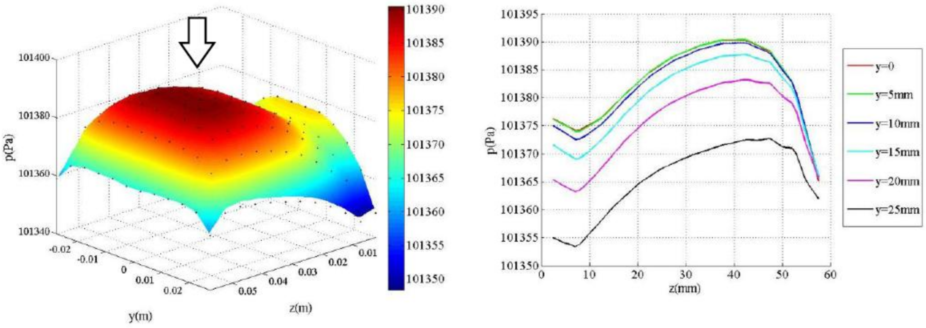
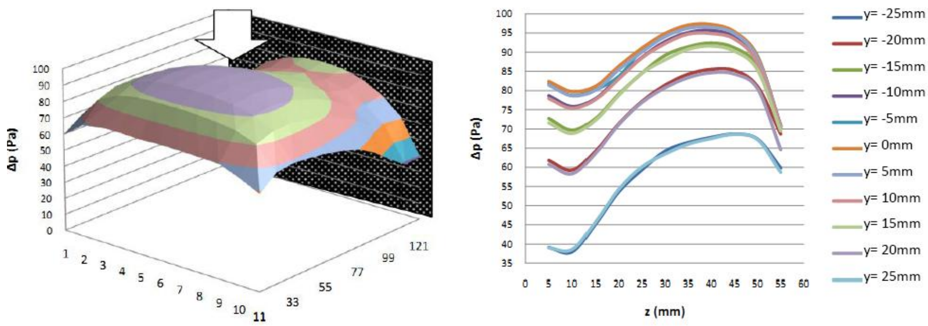
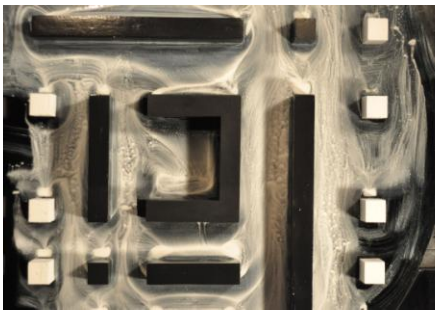


Fig. 4 Distribution of the pressure on the windward (building I) – wind - tunnel results



In spite of the differences, if we compare the numerical results with the experimental results, we may draw a conclusion that they can be used as a supplement to the wind-tunnel studies. In the simple cases (where, for different reasons, the experiment is impossible to carry out) the results could form a base for planning the position of buildings which would minimize negative consequences of wind effects.



Further wind tunnel investigations and numerical simulations are still at a stage of development and are considered with a more complicated system of buildings The results will be presented in the near future.

Fig. 5 System of buildings – oil vizualization

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