Airflow in urban street Canyons located in Valespartera

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Abstract

The results of a CFD (Computer Fluids Dynamics) simulation are study examining the steady exchange of air and heat between a building and an urban canyon are presented. The study was made for Valdepartera urbanization located in Zaragoza. The focus is on the effect of the canyon aspect ratio on the airflow through openings made exclusively in one side of the building. The interaction of the external wind flow and the internal thermally-driven flow was shown to depend upon the ratio of the building height H to the canyon width W (distance between buildings forming the canyons). (Syrios, K., 2007).

Introduction

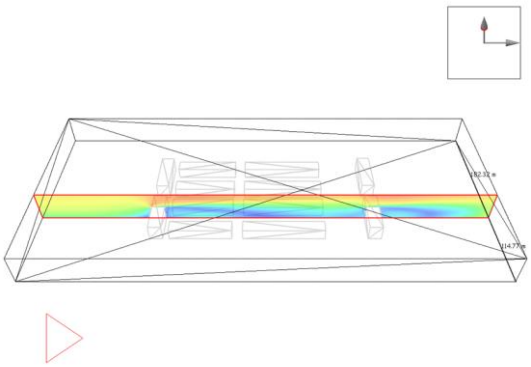
This paper is devoted to the study of airflow in urban street Canyons located in Valdespartera, Zaragoza (Fig 1). Street is one of the most important elements in urban, where population and traffic density are relatively high, human exposure to hazardous substances is expected to significantly increased with buildings are packed and streets are narrow. When considering the ventilation of a building in the urban environment, the position of openings/air inlets are of great importance if the contamination of the indoor air is to be avoided, if openings are placed where the pollutant concentration is high then indoor concentrations can reach similarly high levels (Green and Etheridge, 2001). Accurately predict urban flow and pollutant dispersion can help urban planners to take into account urban geometry with optimal natural ventilation and comfort. (Xiaomin Xie 2005).

CFD techniques allow precise and detailed analysis of the flow field and pollutant diffusion field far more simply than by experiment. This technique has become the most effective means to study the airflow around buildings. The CFD modeling is based on the numerical solution of the governing fluid flow and dispersion equations, which are derived from basic conservation and transport principles, based on the Reynolds averaged Navier Stokes equation (RANS) model (Kato et al., 2003; Davidson and Olsson, 1998).

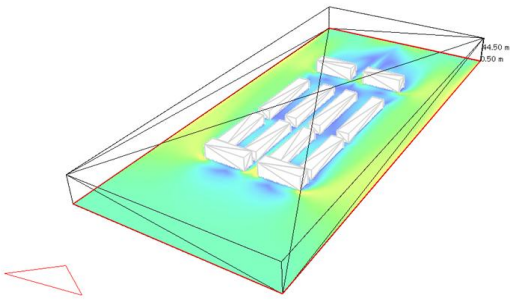
$$\frac{\partial}{\partial t}(\rho\phi) + div(\rho\pi\phi) = div(\Gamma grad\phi) + S$$

Results

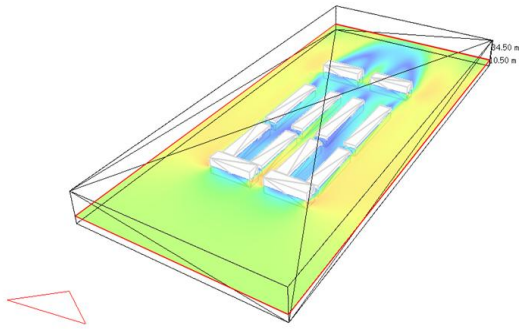
The influence of ambient buildings structure, the flow field can be influenced not only by the configuration of street buildings but also the configuration of ambient buildings.



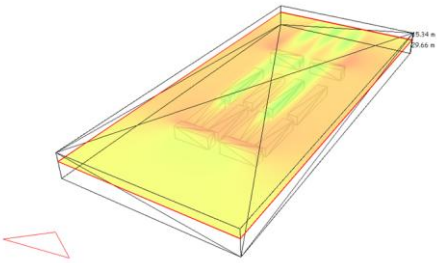
The model simulated in Valdespartera is enhance the leeward building of the upstream street. When the height of building is enhanced the clockwise in the studied canyon is coupled with the clockwise vortex in the upper region of the second canyon that extends to the flow field with enhanced building height of two sides border upon is similar to the case that the height of the building is enhanced, the difference is that the vortex center become higher and the fluxion in the street canyon become weaker.



Airflow at 0.5 meters



Airflow at 10meters



Airflow at 30meters

Conclusions

The urban planning must consider the use of a height building to reduce the urban canyon effect in streets. The simulation shows the reduction against 0 m/s with the appropriate building protection.

Overall, this study suggests that the in canyon air quality can be significantly altered by introducing tree planting in urban planning stage. In this context, the combination of experimental and numerical investigations can provide useful suggestions for assessment, planning and implementation of exposure mitigation in street canyons with tree planting.