NUMERICAL AND EXPERIMENTAL MODELLING OF POLLUTANT DISPERSION IN A STREET CANYON

Ana Garcia Sagrado, Spain
Supervisors: J.P.A.J. van Beeck & P. Rambaud

Due to the continuous increase in city traffic, it is of actual importance to find out how the vehicular pollution distributes inside the streets. Therefore, pollutant dispersion in a street canyon is studied in this project. The principal parameter investigated is the height of the downstream building. The street canyon model consists of two blocks of wood with enough length in comparison with the cross section in order to consider a 2D study. The pollutant source is situated in the middle of the street. This configuration has been called «open country».

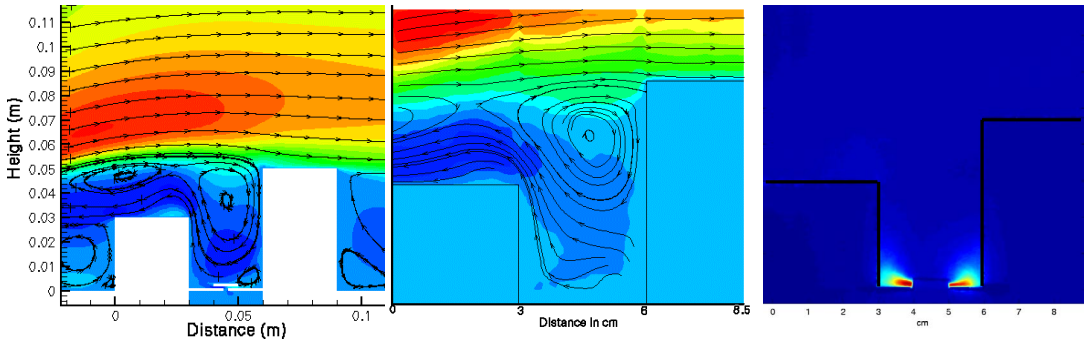
The investigation has been performed in two ways: on one hand, experiments have been carried out in the L-2B wind tunnel at von Karman Institute and on the other hand, numerical simulations have been performed using the commercial software Fluent 5.2.

In the experimental part, the concentration measurements have been performed by means of a Light Scattering Technique. Mean and instantaneous concentration fields have been obtained with a video camera and digital image processing. The velocity field in the street has been measured by Particle Image Velocimetry.

In the numerical simulations, a preliminary study about the backward-facing step has been performed in order to select the best turbulence model for these complex flows, characterized by separation, stagnation, recirculation, reattachment, etc. The best model appeared to be the realizable k-ε model with the two-layer zonal approach to the wall, which predicts the reattachment length after the step with less than 1% error in comparison with the value obtained from Direct Numerical Simulations. This model has been applied in the street canyon simulations. Qualitatively there is good agreement when comparing the mean flow patterns, although some discrepancies have been observed inside the street canyon. These differences are more evident when comparing quantitatively the results as it has been confirmed by velocity and concentration profiles.

Besides the height of the downstream building, the influence of a third building located upstream of the street canyon on the flow and dispersion inside the street has been investigated. A lower concentration has been found inside the canyon in comparison with the open country cases.

Increasing the height of the downstream building decreases the pollutant concentration inside the street.



Fluent mean velocity field; Contours of x-velocity

PIV mean velocity field; Contours of x-velocity

Light Scattering Technique; Contours of concentratio