EXPERIMENTAL METHODOLOGIES FOR ENVIRONMENTAL FLOW STUDIES – GAS DISPERSION AROUND ROAD TUNNEL EXITS AND SAND EROSION TECHNIQUE FOR WIND COMFORT ANALYSIS

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The present thesis work involves the analysis of velocity and concentration fields in urban and extra-urban areas affected by the presence of infrastructures. Experimental methods are applied to investigations of pedestrian level winds in urban areas and pollutant dispersion in the surroundings of road tunnel exits. The issue of assessments of pedestrian comfort in wind tunnels is the definition of the zones where the probability of discomfort due to the wind reaches the levels defined by the comfort criteria or air quality standards.

Investigation of pedestrian level winds has been carried out by the well-known technique of sand erosion, often used in wind comfort analysis. An examination of the possibilities of the technique showed interesting relations between the scoured zones and the probability of occurrence of a certain event, 'gust'. This propriety would make the results of the sand erosion directly related to wind comfort requirements. If the friction velocity inducing the take off of the sand could be related to a certain velocity at pedestrian level, it could also provide easy accessible data to all the users. In this sense an assessment of a quantification of the results has been performed, comparing the scoured zones with post-processed PIV data acquired on a horizontal plane at a "pedestrian" height from the ground.

A review of the procedure for a correct use of the technique has been required Microclimate analyses carried out by sand erosion technique have been applied to a simple urban configuration. The surrounding area of an isolated tall building has been investigated. Different geometries and orientations with respect to the wind have been taken into account, stressing the location of sand-scoured zones at higher wind speed.

In the second part of this thesis work, an experimental and numerical methodology has been applied to the investigation of a concentration field of an area surrounding road tunnel exits. Experimental tests carried out on a scaled down model have been compared with CFD simulations. The configuration reproduces a 2D hill with gentle slope, crossed longitudinally by two pipes simulating the two road tunnels with flows in the two directions. The main factors affecting the phenomenon and the influence areas have been identified, pointing out the zones affected by high concentration levels. A comparison between the numerical and experimental results has been discussed, stressing the complementarities of the two methods of analysis.

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