SAND EROSION TECHNIQUE FOR MICROCLIMATE ANALYSIS

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Pedestrian comfort analysis is often required for build-up area in urban environment. The microclimate analysis consists in the evaluation of the effect of infrastructures located in the site.

Sand erosion is often used as a visualization technique in microclimate studies. The scope is pointing out the zones where the strongest effect of the structures is located. The aim of the research was to up-grade the technique to a quantitative technique in order to compare the sand erosion results with the comfort criteria. The purpose was trying to find a quantity characteristic of the flow field at pedestrian height describing the contours of the area where the sand torn off. Some comparisons with standard techniques (PIV and oil flow visualization) were performed in order to analyze these sand erosion contours. The influence of different statistical parameters was compared with the sand results. Since the take off of the sand grain is related to the appearance of a certain event (certain critical friction velocity) some estimations of the maximum velocity were tested. Then parameters used in microclimate were tested. The Gust velocity ($V_{mean}+g$ RMS where g is the Gust factor) was the main parameter. The isolines for these tested parameters showed some similarity but none of them a direct link to the sand patterns. Some directions for further investigations were found. Effect of the third component of the flow, of vortexes and of a differentiated treatment of different zones should be taken into account in the analysis.

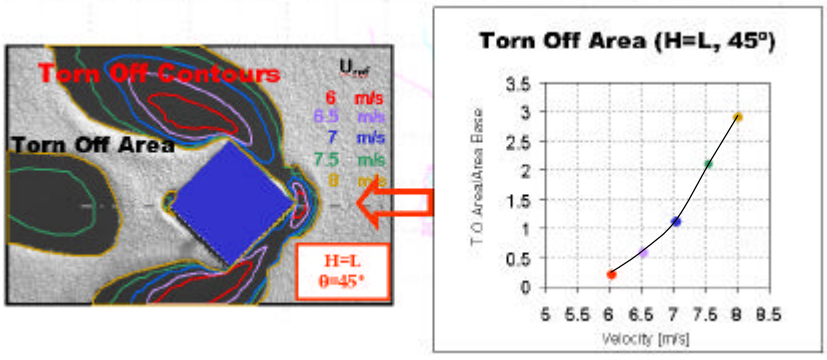

Figure 1: In figure a typical picture of sand erosion results is depicted. The torn off area shown (black zone) is for the configuration with wind velocity equal to 45º and building height equal to the building length. The velocity is the highest one (U_{ref}=8 m/s). The contours of the zones where the sand is torn off are described in colored line, with different colors for different velocities. The correspondent velocities (U_{ref} = reference velocity of the free stream) are shown in the right up corner of the picture. In the plot on the left the torn off area computed from the images were non-dimensionalized with the area of the model base and plotted in function of the U_{ref}.

A parallel study about the effect of building height at ground level was performed by means of the sand erosion technique. Three different directions of wind (0º, 45º, 22.5º) and four different building heights (H=L, 3L, 4L, 5L, where L is the base length and H is the building height) were tested in order to have a complete series of cases. The results showed the critical zone for pedestrian comfort for the several cases and the influence of the building height is pointed out.

For H/L>1 the discomfort area increased slowly with increasing building height. For a building height bigger than the boundary layer thickness, no more influence of H was observed.

The most critical zones are the zones close to the frontal edges in every case. The frontal area seems to be limited from the separation line, even for the biggest velocities. For buildings with H/L>1 the back zone can be classified as critical but it has a good microclimate for H/L=1.