WIND TUNNEL TESTS FOR THE ASSESSMENT OF WIND AND SNOW LOADING AT THE "CENTRAL MARKET BUILDING" OF LIVORNO

Francesco Gianola, Italy
Supervisor: J.P.A.J. van Beeck

The object of this project is the Central Market of the city of Livorno, one of the most important historical constructions of the city, built in 1896. This work takes rise from a previous study carried out by the Department of Structural Engineering of the University of Pisa within the frame of a convention concluded with the City of Livorno. During the execution of renovation works, the City of Livorno asked for an assessment of the actual safety level of the metallic roof of the Market. Such study had as main scope the assessment of the static situation of the structure verifying that indispensable requirements of resistance, stability of the equilibrium and functional efficiency, necessary requirements for the safety of the people approaching it or working inside, were satisfied, quantifying the actual safety level by comparison with any modality of structural crisis. The preliminary investigations revealed a lack of safety under some combinations of snow and wind loads prescribed by the Italian Code, which appeared to be excessively severe and unlikely to occur at that site. The results put in evidence the need of a knowledge improvement about the interaction between the wind flowing around the building and its structure, with special attention for the roof area.

The experimental study is mainly focused on two aspects: (1) to check if these load scenarios derived by the norm are likely to happen for this building configuration and (2) to evaluate the wind loading on the metallic roof covering structure. The technical norms themselves provide for wind tunnel tests and/or properly numerical methods to be performed in order to obtain a better load and response information, using appropriate models of both the structure and the natural wind.

Sand erosion test were carried out in the VKI atmospheric boundary layer L1-B wind tunnel with a rigid scaled down model of the market and its surroundings. Similarity based upon the geometrical criterion introduced by Anno (1983) allows using the sand erosion technique for the identification of snow erosion and deposition areas. Besides, a model instrumented with 325 pressure taps was used for the mapping of the mean pressure coefficients on the upper half of the market.

Results from sand erosion tests showed that snowdrift scenarios provided by the norm were not reproduced in the tests allowing to reject worst case scenarios and to define more realistic snow loading scenarios to be used in the structural analysis. The integration of the mean pressure map yield mean drag, lift and moments on the structure and reveals critical zones for wind loading. The measured mean pressure coefficients showed good agreement when compared to the new Eurocode EN1991-1-4(2005).

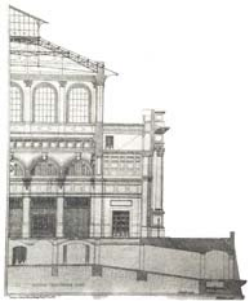

Figure 1 Transversal section of the Market building

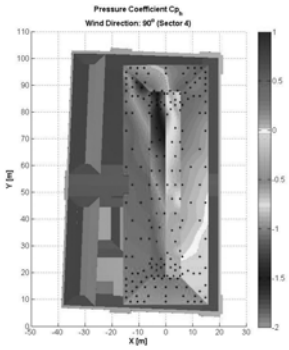

Figure 2 Experimental pressure map (pressure coefficient)

Figure 3 Sand erosion tests