Wind loading: a work-flow for systematic comparison between CFD and experimental data

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ABSTRACT

Computational Fluid Dynamics (CFD) is nowadays widely adopted for investigating fluid flows around buildings and it is becoming a precious tool also for design proposes. A seminal review of the potential and limitations of CFD in Wind Engineering has been recently proposed by Bloken [1].

Despite the wide diffusion of such computational techniques, their reliability is often unclear especially when the goal of the analysis is to predict pressure distributions and, thus, wind loads. The difficulty lies in the fact that the high Reynolds number flow around bluff bodies is an extremely non-linear phenomenon which is dominated by flow instabilities. Furthermore, the broadband nature of turbulence (in terms of both time and spacial scales), represents a non-trivial obstacle for its numerical simulation which, at the present time, appears extremely computational demanding and sensitive to the adopted turbulence model, numerical methods and mesh sizing [2].

A large amount of literature can be found focusing on the improvement of the currently available computational tools and the comparison between experimental and numerical data. Results obtained with different models (RANS, LES, DES) are compared to experimental results in terms of pressure statistics and flow bulk quantities. Nevertheless, to the authors knowledge, at the current stage, no clear distinction between the design and the prediction problem has been proposed in the wind engineering community. From such view point, it might be convenient to analyse the results obtained by using CFD in terms of structural response rather than flow statistics. As an example, some regularities in the biases induced by the k-ω sst model in the evaluation of flutter derivatives has been observed in [3,4].

To this purpose, a software has been developed aiming at allowing systematic evaluation of the structural response starting from both experimental and CFD data. A first validation of the work-flow has been conducted on the UNIPOL Tower, located in Bologna showing encouraging results.

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