Transient Wind Loads on Complex Façades

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Abstract

Wind-induced pressures are often the controlling factor in sizing, detailing and performance of a façade, with a direct relation to cost. As a result of the push to design energy efficient buildings, façades have become more geometrically intricate with a significant effect on the flow over the building surface. There are several instances where the wind induced pressures on such facade elements are not covered by codes of practice, or are too small or complex to be included in conventional wind tunnel testing due to their small modelling scale. A significant number of high performance façades now use ventilated double skins, or include intricate attachments such as external shading devices, for which little research is documented.

Prediction of the transient load history on such complex façade surfaces requires detailed pressure information, which is in turn used to feed in to material strength models. This study uses a relatively large model in a scale of 1:10, in contrast to common wind tunnel scales of 1:200 to 1:400. This allows the modelling and instrumentation of far more detailed façade elements, which is not possible at smaller scales. The work focuses on double skin facades and shading devices however, it is expected that the fundamental research undertaken in this area should be easily transferable to other façade typologies.

Results show how the local wind flow on external elements affects façade surface pressures, highlighting potentially significant effects on design. Net pressure coefficients applicable for the design of smaller façade elements are also given in relation to surface pressures. It is shown that a correlation between mean and peak pressures can be identified in certain cases, indicating that a quasi-steady approach to analysis may be appropriate.

These results are used to validate Computational Fluid Dynamics (CFD) models for façade mean pressure computations. It is envisaged that CFD will be used to augment wind tunnel data where it is impractical to model intricate facade details in small scale wind tunnel models. The computational basis also offers the façade designer the possibility of parametric design optimisation or assessment of design variations at a minimum cost.