Title: *Etude du vent sur un Immeuble de Grande Hauteur. Application sur l'Ural Tower*
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ABSTRACT

The behaviour of the wind around the structures is a complex and essential subject to study in order to be able to develop the wind engineering and to apply it to the structures. We were used to design low and medium-rise structures by a simple quasi-static treatment of wind loading. Nevertheless, this treatment can result in an underestimation of the loads for design of very tall buildings, because in those cases there appear other important issues need to be treated in the design of structures which cannot be done with such a treatment. Those issues are: dynamic response, interference from other structures, along and cross wind response, etc. It is very important to understand the way all those parameters influence the wind design and to take them in account in order to provide satisfying calculation of wind loading for design of very tall buildings.

Flexible structures may fall due to excessive levels of vibration under the action of wind, adversely affecting the comfort of its occupants (which is normally evaluated using the peak acceleration). Studies of the perception of acceleration on high buildings describe that it tends to being dominated by the cross-wind, because of the vortex formation around the structure. To ensure the functional performance of flexible structures, some modifications in their design can be made or alternative structural systems such as the utilization of passive and active control devices can be used.

Although designing damping capacity into a structural system is not yet a routine design practice, neither is considering the need for other mechanical means to increase the damping capacity of a building, this have become increasingly common in the new generation of tall and super tall buildings. The selection of a particular type of vibration control device is governed by a number of factors which include efficiency, compactness and weight, capital cost, operating cost, maintenance requirements and safety. The capital and operating costs depend on the required level of response reduction, whether the system is a passive or an active one, and the degree of complexity of the system. To reduce wind-induced response of tall structures, particularly in relation to acceleration response with respect to human comfort requirement, mass dampers (in either passive, active or hybrid form) are most frequently used with over 20 major installations in buildings and observation towers worldwide.

The vast majority of investigations so far on the feasibility of vibration control of civil engineering structures under wind excitation have been based on theoretical analysis and numerical simulations. For the very tall buildings, wind tunnel testing has the potential benefits of further refinement in obtaining design wind loads. After many measurements, it is possible to say that the major benefits of an active control system are the smaller damper mass and higher efficiency: while a conventional tuned mass damper may provide an additional damping of 3% to 4% of critical damping, an active system can add 10% or more. Furthermore, hybrid mass damper systems have recently been introduced to exploit the benefits of both the conventional tuned mass damper system and active control system.

This report presents the basis of wind engineering and wind behaviour around high buildings, by detailing the problems which appear: perception of movement, decreasing human comfort, etc. The possible solutions will be analysed and detailed while a constant return is made on Ural Tower (385m high), the project on which I worked, and that will be situated in Ekaterinburg (Russia).

Keywords: wind excitation, tall buildings, wind tunnel testing, acceleration, damping