CZ.1.05/1.1.00/02.0060: The increase velocity flow simulation inside the aerodynamic section of the wind tunnel

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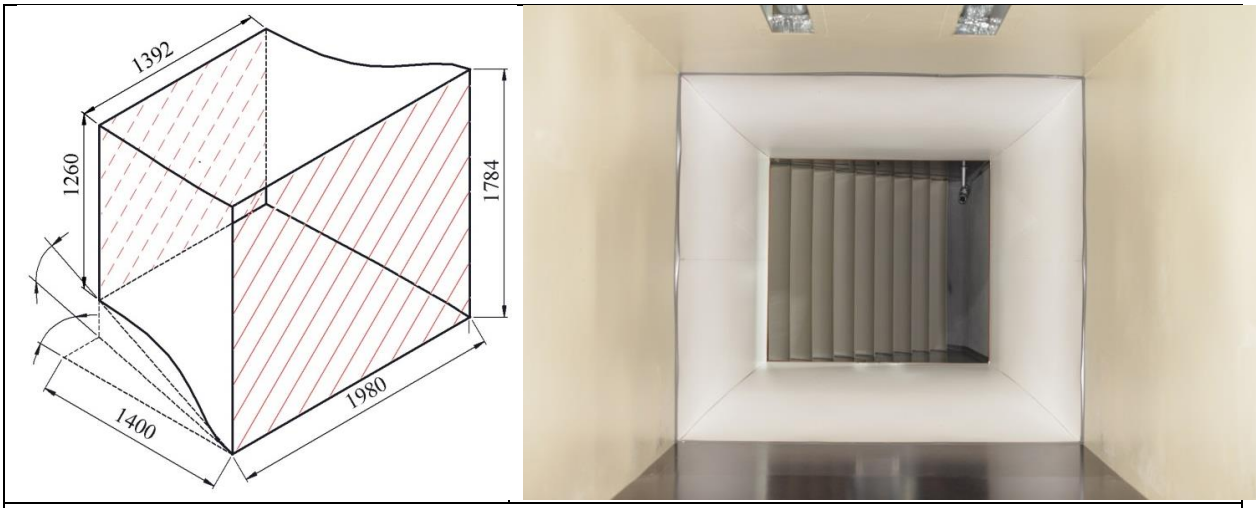
A crucial characteristic of a wind tunnel is the controlled flow quality inside the test chamber and the overall performances. Three main criteria that are commonly used to define them are: maximum achievable speed, flow uniformity and the turbulence level. Sometimes, the outmost quality is reached with the design of an additional contraction part allowing a controlled flow in the test chamber.

Additional contraction nozzles are normally installed upstream of the test section and serve two main purposes. Firstly, a contraction increases the mean velocity of the flow and thus reduces the pressure losses and hence the ventilator power consumption. Secondly, since the total pressure remains constant through the contraction, both mean and fluctuating velocity variations are reduced to a smaller fraction of the average velocity at a given cross section: this also means that, in principle, fewer screens would be required in the settling chamber, thus reducing the pressure losses even further.

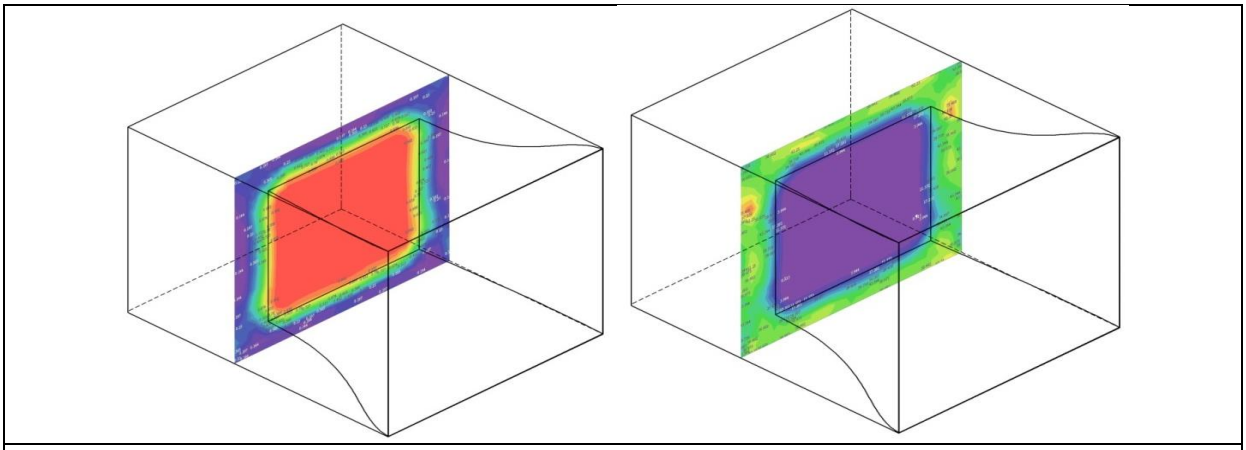


Left-Geometrical parameters of the contraction. Right- Test part of the aerodynamic section of the Climatic Wind Tunnel "Vincenc Strouhal" (downstream view)

The main benefit of inclusion of an additional contraction nozzle will be a creation of a variable open-jet test section for full-scale and model scale testing. It has a cross-sectional area of 1.39 × 1.26 m^2. Size variation is achieved by a rectangular contraction with two interchangeable outlet sections resulting in overall contraction ratio of 2.02. The wind speed in such modified test section varies between 1 and 55 m/s. The design criteria for the contraction shapes were to avoid the boundary-layer separation as well as velocity non-uniformity in the outlet cross-sectional area. The later one should be less than 1% (in terms of turbulence intensity value) after the modification. Additionally, it was desired that the interchangeable outlet sections should also be as short as possible in order to ease the handling of these components.

An airflow speed and a velocity distribution field are defined parameters of shape contraction, its length and the constriction ratio. The quality of airflow has changed due to

the compression of air stream and reducing of the contraction outlet cross-section area. The velocity uneven distribution was 0.79% in accordance with the experimental results.



Flow characteristics of the working part: a) velocity; b) turbulence

Flow quality, which is one of the main characteristics, is a result of the complex design, and can only be verified during calibration tests. However, empirical knowledge gives important hints in selecting the adequate values of the variables that affect the quality of the required parameters.