A NEW LOW-SPEED CIRCULAR WIND TUNNEL

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Measurement is an integral part of the design, development and practical verification of real qualities of the proposed devices. Their use in aerodynamic applications is an integral part of development of aviation and rocket technology from the outset.

Aerodynamic measurements are still irreplaceable in the development of new aviation techniques, although the current period is characterized by intensive development of numerical methods and computer simulations of all kinds.

Computational methods are still inconclusive in the areas of simulation blowing unconventional aircraft and do not provide sufficiently reliable results for engineers. Incorrect input aerodynamic data may cause either significant time lag in development of new aircraft, or may also lead to significant financial losses and problems associated with the late start of the new product to market. In the numerical calculations can be considered one of the main problems the absence of input and boundary conditions, which would properly characterize the real aerodynamic effects.

An integral part of these activities is the design and implementation of test equipment. New, modern designed and equipped testing equipment generates the necessary facilities for the implementation of quality measurement. The level of equipment corresponds to the current requirements.

At the University ofs Defence in Brno at the Department of Aircraft and Rocket Technique are being built and developed new, advanced test equipment for experimental aerodynamics. The last significant test equipment for experimental aerodynamics is a new low-speed circular wind tunnel (WT) with an open measure area. The newly constructed WT is with its size the largest test equipment that is used either on campuses or in the entire region of Central Europe.

Fig. 1 Overview of the new WT with installation of the measured object in the measure area.

Basic technical parameters of the new wind tunnel are:

The newly constructed wind tunnel is made as semicoque wooden structure. The whole device is located on a surface area 13 x 27 meters. The highest point of the construction is located at a height of 7 m above the floor of laboratory.

The heart of the wind tunnel is the axial fan made in the Czech Republic with diameter 2.8 m driven by an asynchronous electric motor with an output power more than 200 kW. The concept of WT is designed to allow variably change size of the output nozzle. The shapes of the output nozzle include horizontally and vertically oriented rectangle, square and octagon.

The shape of the output nozzle is dependent on the type of measurement application. The cross section of output nozzle is nearly 6 square meters at maximum opening area – dimensions are 2.43 x 2.43 m. The maximum flow rate through the nozzle is 220 m^3 of air per second in such mode.

When using the output square nozzle with dimensions 2 x 2 m we can expect air stream velocity of 180 km/h in the measurement area.¨

Fig . 2 Overview of the WT power unit and its control system.

The types of measurement applications.

Based on the requirements of the investor was built a new testing device that would allow measurement of both airlines and non-airline applications

The aim of presented WT laboratory is to provide the test equipment for the widest possible range of users and for the widest spectrum of industrial and leisure time applications.

Between the first tasks we can include measurement of aerodynamic characteristics of the propellers, wind turbines, main rotors of helicopters and propeller drive systems for unmanned aerial vehicles (UAV / drone), respectively propeller drives for paragliding, motorized gliders and a small sport aircrafts.

The measurements of these applications are experienced at our workplace for a long time. We were limited with the size and performance characteristics of our existing small wooden tunnel so far. The small size of the WT was an obstacle for measurement of larger propeller systems.

Another important area of the aerodynamic measurements is variety of automotive applications. These include either measurement of individual parts of this technique – measurement of formula´s wing – or measurement of all techniques at an appropriate scale.

An interesting application of aerodynamic measurement is the area of sport leisure time activities. These activities include finding the optimal positions of downhill skiers, ski jumpers, cyclists, skaters, racing motorcyclists and others.

One of the main requirements that the implementation team provided was to build a modern low-speed aerodynamics experimental laboratory and educate a team of young scientists – e.g. students and others who are interested in this branch.

This laboratory will allow verify the parameters of existing and newly developed equipment focused on the various industrial areas.

Conclusion

For the successful implementation of the main requirements is expected to close cooperation among universities in Brno and also with participants from other regions.

Now, the adaptation of the tunnel duct and its measuring section is realized. The result of adaptation will improve the flow field parameters in the measure area – section – including automation of measurement and evaluation of obtained data.