PROJECT AND CONSTRUCTION OF WIND TUNNEL FOR AERODYNAMIC RESEARCH

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Abstract. *The study of the aerodynamics is related to the improvement in the acting of airplanes and automobiles with the objective of being reduced the effect of the attrition of the air on structures, providing larger speeds and smaller consumption of fuel. The application of the knowledge of the aerodynamics not more limits to the aeronautical and automobile industries. In that way, being tried the new demands with relationship to the aerodynamic study in the most several areas of the engineering, this work presents the stages of the project and construction of a wind tunnel for application in aerodynamic rehearsals. Among the several configurations of existent wind tunnels, opted to build open circuit, due to smaller construction complexity and installation; operational simplicity and cost reduced. Belonging to the type blower, to take advantage of a larger efficiency of the motor; and with difusion so that flowed him of air it wins speed before reaching the section of rehearsals. The guidelines for project were: didactic practices: study of the layer it limits and analyze of the drainages on proof bodies with different geometries. For the pressure variation in the test section a connected manometer used a pitot tube. Quantitative and qualitative results showed to be satisfactory.*

Keywords: Wind tunnel, Aerodynamics, Air.

1. INTRODUCTION

The study of the aerodynamics is related to the improvement in the acting of airplanes and automobiles with the objective of being reduced the effect of the attrition of the air on structures, providing larger speeds and smaller consumption of fuel. The application of the knowledge of the aerodynamics not more they limit to the industries aeronautics and automobile. The study of the forces generated on submerged objects in a draught it is applied to the development and optimization of projects and products in areas as sport, ergonomics, industrial design and it would engineer mechanics and civil. The aerodynamic study can be accomplished being used tunnels of wind of different types, which can be classified in function of the construction position (vertical or horizontal), of the type of the camera (open or closed) and of the speed of the fluid (subsonic or hypersonic). in general, a wind tunnel is composed by a convergent mouthpiece, a test section and a fan. The convergent mouthpiece is a fundamental component for an aerodynamic evaluation with smaller involved uncertainties. According to Bell and Mehta (1989) the principal effects of the mouthpiece are the reduction of the flotation of speed in the test section and the increase of the medium speed of the drainage. The test section requests cares in the production and assembly allowing the drainage to be as uniform as it is possible, it exempts of angles and with the minimum of whirls (FOX and McDONALDS, 1998). This study proposes the project and the construction of a wind tunnel for the accomplishment of aerodynamic rehearsals seeking the best understanding of the interaction between the fluid and the structure, on the part of the academics of the course of mechanical engineering of the Federal University of Rio Grande do Norte.

2. THEORY

To simulate the effect of the air passing on the surface of the trucks of the vehicles, it was necessary the construction of an aerodynamic tunnel.

Among the several configurations of existent wind tunnels, she opted to build one of open circuit, due to smaller complexity for installation and handling. Belonging to the type blower, to take advantage of a larger efficiency of the motor; and with diffuser so that flowed him of air it wins speed before reaching the section of rehearsals.

The tunnel possesses the following characteristics: total length of 4,5m; rehearsal section with dimensions of 0,50m X 0,50m, with 0,25m2 area; maximum speed of approximately 9,7m/s, obtained using a monophase electric motor, with maximum potency of 5HP (3.7kW). Diffuser with reason of contraction of 2:1, in other words, with larger section of 1m X 1m, and section smaller 0,50m X 0,50m, that according to Catalano (1998), does with that flowed him when passing for that area has an increase of the speed due to decrease of the pressure. Fig. (1; 2; 3; 4; 5 and 6) and Tab. (1), they detail the construction and assembly of the tunnel.

Figure 1. Molds for the diffuser.

Figure 2. First built piece.

Figure 3. Assembly of the contraction.

Figure 4. armed Diffuser.

Figure 5. Construction of the section of rehearsals.

Figure 6. Centrifugal Fan.

Table 1. Dimensions of the wind tunnel.

Specifications of the Aerodynamic Tunnel	
Length	4,5 m
Maximum height	1 m
Maximum width	1 m
Type of the tunnel	Soprador
Maximum potency of the motor	5 HP (3,7 kW)
Area of the rehearsal section	0,25m^2
Maximum speed of the rehearsal section	9,7m/s

In the tunnel of used wind, the air is blown by a centrifugal fan, moved by a motor alternating current tramway. The air goes by a diffuser in which there is in your exit extremity to a box of the type beehive.

It was also projected and built a camera of stabilization with a rectification of flow of the type beehive. They were considered in the dimension of the camera of stabilization the observations of Mehta and Bradshw (1979), according to which the length of the honeycomb should be from six to eight times the medium diameter of the cell, and the recommendation of Groff and Alé (2000), that stipulates a strip for the thickness of the wall of the cells between 0,5 and 2,0mm. the beehive was built starting from tubes of PVC, that were cut with 200mm of length each one. Those parts were mounted and agglutinated, forming 625 cells of square section 50x50mm. In Fig. (7) the final assembly of the beehive can be observed.

Figure 7. Box of uniformization of the type beehive.

After the diffuser, the drainage suffers an acceleration, due to the presence of a contraction in the which the drainage suffers a pressure loss, that is, turns into kinetic energy (speed) that goes to the rehearsal section. The whole construction of the structures of the tunnel (diffuser, contraction, rehearsal section), they were accomplished by techniques used by Catalano (1998). Parts as: The box of uniformization of the drainage; the cooker hood to retain the coming vibrations of the motor and the helix of the motor for generation of the wind, technical were accomplished used at the Laboratory of Aerodynamics of Vehicles of the Lutheran University of Brazil - ULBRA. Fig. (8) it shows the schematic model of the wind tunnel.

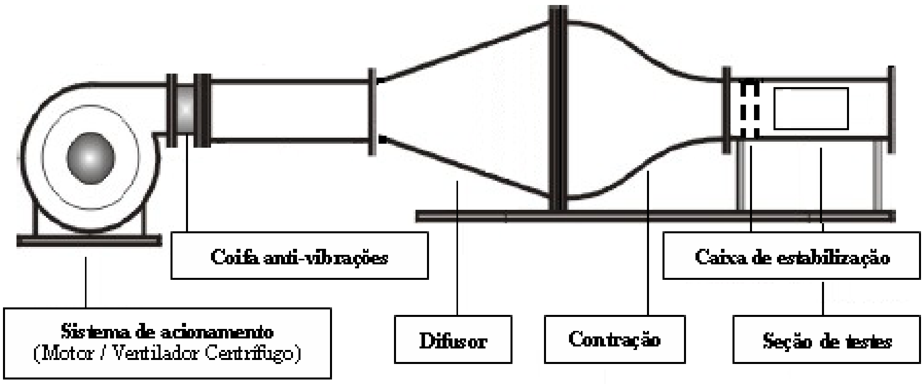

Figure 8. Model schematic of the wind tunnel.

4. RESULTS AND DISCUSSION

In the Figure 9 the tunnel of projected wind is presented. However, the project stage and construction is in final phase, as aerodynamic scale and system of smoke for visualization, for the longed for didactic practices.

Figure 9. Tunnel of installed wind.

An important result was obtained starting from the star-up of the tunnel. It is treated initially of the inclusion need to the project foreseen of the expansion camera with the uniformisation beehive, reason of the rotation effect imposed to the drainage by the axial fan. For it tests them initials objects of different formats they were used, chosen in an aleatory way.

5. CONCLUSIONS

Before the rehearsals accomplished in elapsing of this research, the wind tunnel behaved in a satisfactory way, having reached the objective for which was built, being this of easy construction, simplified operation and of low cost. The expansion camera with beehive was fundamental to minimize the effect of the rotation imposed to the drainage by the axial fan.

6. ACKNOWLEDGEMENTS

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