Labor Windkanal/Strömungsmesstechnik

FACHHOCHSCHULE REGENSBURG
UNIVERSITY OF APPLIED SCIENCES
HOCHSCHULE FÜR TECHNIK WIRTSCHAFT SOZIALWESEN

Aerodynamic Properties of the RWT (Regensburg Wind Tunnel)

Mark Becke

e-mail: Mark.Becke@gmx.de

Mechanical engineering, Galgenbergstr. 30, D-93053 Regensburg - Germany, Head: Prof. Dr.-Ing. Stephan Lämmlein
http://www.fh-regensburg.de

Introduction

In the Laboratory Wind Tunnel/Flow Measurement of the Department Mechanical Engineering at the University of Applied Sciences Regensburg a **new Wind Tunnel** was started up in February 2006. This *Regensburg Wind Tunnel* (RWT) shall suite mainly the purpose of education but also of scientific investigations in context of theses and service tasks.

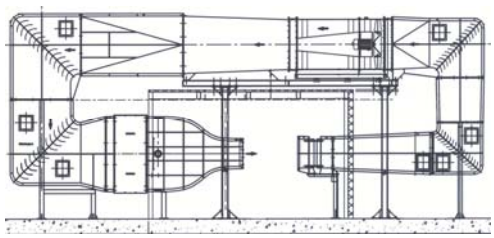

Fig. 1: Abstract draft of the RWT

The object of the work is to reproduce, specify and extend the results for relevant parameters of flow quality, determined at the official aerodynamic certification. This investigation was effected with the measurement equipment of the laboratory.

Focus of Investigation

The intention of the work is the **documentation** and the **evaluation of the flow quality** of the RWT depending on the layout of the test section (open, closed) and the flow velocity. The parameters, relevant for estimation of flow quality in the test section, are:

- **Velocity**, considered as:
  - *Local unequality of flow velocity* as the deviation of the velocity in one measuring point in a plane orthogonal to the main direction of flow from the average of the velocities of all measuring points within this plane, according to

$$\kappa_i = \frac{u_i - \bar{U}_E}{\bar{U}_E}$$

  - Velocity distribution along the centerline of the test section

- **Turbulence intensity**, considered as:
  - *Longitudinal turbulence intensity* in several planes of the test section orthogonal to the main direction of flow and along the centerline of the test section, according to

$$Tu = \frac{u_{rms}}{\bar{u}}$$

- **Pressure gradient**, considered as:
  - *Nondimensional static pressure coefficient* along the centerline of the test section, according to

$$c_{p,stat} = \frac{p - p_\infty}{\frac{\rho}{2} u_\infty^2}$$

Set-Up

The measuring of velocity and turbulence intensity was performed according to the principle of **Constant Temperature Anemometry** (CTA) with the system *StreamLine* from Dantec Dynamics and a hot wire probe in the open und closed test section of the RWT. The pressure measurements were performed with a multi-channel *Pressure Scanner 9016* from PSI and a pitot static tube because of the limited accessibility only in the open test section.

Fig. 2: Open test section

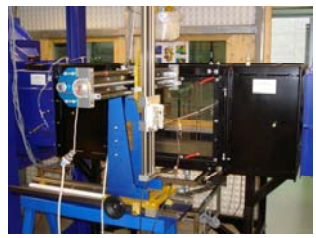

Fig. 3: Closed test section

The positioning of the several probes was performed with the automatic moving device *FloSSy*. Hereby several planes orthogonal to the main direction of flow with each 45 measuring points and 13 measuring points along the centerline of the test section could be approached with repeatable accuracy.

Conclusions

The evaluation of the measuring data shows that the flow quality in the closed test section is much better than in the open test section considering velocity distribution but mainly turbulence intensity because of the lack of shear layers.

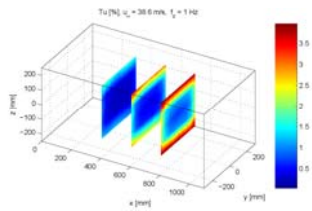

Fig. 4: Turbulence intensity in the open test section

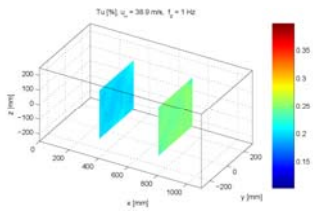

Fig. 5: Turbulence intensity in the closed test section

The static pressure raises noticeable in the open test section not until the half of the length of the test section, the velocity decreases along the centerline of the test section accordingly.

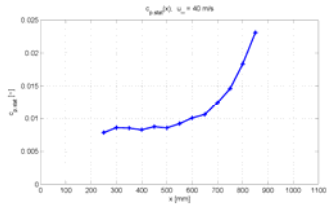

Fig. 6: Static pressure coefficient in the open test section

References:

- ECKELMANN, H.: *Einführung in die Strömungsmesstechnik*. Stuttgart : Teubner, 1997
- JØRGENSEN, F.: *How to measure turbulence with hot-wire anemometers - a practical guide*. Dantec Dynamics A/S, 2005
- FIEDLER, H.: *Turbulente Strömungen*. Technische Universität Berlin, Hermann-Föttinger-Institut für Strömungsmechanik, 2003