CZECH TECHNICAL UNIVERSITY IN PRAGUE

Faculty of Mechanical Engineering, Department of Process Engineering

Review of Diploma Thesis

Study program: Mechanical Engineering

Study field: Process Engineering

Author: **Tugsan Alav**

Title: **Investigation of the test section of a small wind tunnel**

The thesis focused on CFD simulation and analysis of pressure and velocity fields in a test section of a wind tunnel using software ANSYS.

Formal comments and mistakes

There are many formal and typographical mistakes in the thesis, some of them are mentioned below, some were denoted in the thesis.

Page 4 – it is not clear what Lts represent in the text. Similarly, in Figure 2, what means VL label on the horizontal axis? It is also not clear where Figure 2 comes from. It should be noted in its caption.

Page 5 – Equation (2.2) and all other equations: symbol $*$ is usually not used as multiple operator in equations.

Page 5 – Equation (2.4), symbol ϱ should be there instead of q probably.

Page 11 – before Eq. (2.16), there is symbol (γ) for heat capacity ratio, but k is used in equations before and after.

Page 13 – De-Laval nozzle should be written as "de Laval", without the dash. I have never seen it with dash.

Page 20, Equation (3.19.1) – Cp should probably be C_p. Otherwise it looks like multiple of C and p. Many similar mistakes are in the whole thesis (page 15, txx, Qxx, page 24, $r0$, $r1$, …).

Page 21, Eq. (3.19.7.) – Mach number (and any other dimensionless numbers) should be denoted with upright (Roman) font, Ma, to avoid interpreting this as the multiplication of two variables, M and a in this case. Italic font should be used with variables like p (pressure), x (x-coordinate), T (temperature), etc. It is not consistent within the whole thesis.

Page 29 – the following text seems to be same as the text at Wikipedia (`https://en.wikipedia.org/wiki/Incompressible_flow`) and no reference is mentioned there.

> In fluid mechanics or more generally continuum mechanics, incompressible flow (isochoric flow) refers to a flow in which the material density is constant within a fluid parcel–an infinitesimal volume that moves with the flow velocity. An equivalent statement that implies incompressibility is that the divergence of the flow velocity is zero.

Page 29 – $\nabla * v = 0$ should be $\nabla \cdot v = 0$, it is the so called *dot product* of nabla operator and v.

Page 61 – mistakes or inaccuracies in the list of references, for example:

> 10-Hall, N. (n.d.). Mach Number. NASA. … it should be more specific, what is it, book, article, online resource?

11-INC., A. (2012 . . . , The Usa. . . . INC., A. is not an author, it should be ANSYS, Inc. probably. Usa should be USA.

20-Yunus A. Çengel, J. M. (2006) . . . second author is missing here (Cimbala, J.M.)

Factual comments and mistakes

Chapter 5, Geometry – it is not clear if the shape of the created nozzle corresponded to the Laval nozzle and how it was accomplished.

Page 37, section 6.1.2, Mesh – I would recommend using hexahedral mesh elements, at least within some parts of the geometry. They should give you better accuracy, especially in cases where the flow is aligned with walls. And the mesh quality should improve substantially (it is not good with tetrahedral elements despite what the author states somewhere in the text).

Page 41 – even though it not mentioned there explicitly, I assume that constant velocity (5.5 m/s) was used as the boundary condition at the inlet. The question is if it reflects the real situation.

It is correctly mentioned on page 38 that 3 grids at least are necessary for the grid independence test, but the dependency of some quantity on the mesh size (summarized in Tables 4.2 – 4.5) was not evaluated in the thesis. This could help with estimation of the numerical accuracy which is the basis of any grid independence analysis.

I miss some comparison of turbulence models in the thesis. According to simulation files provided by the student, it seems that standard k-ε turbulence model was used along with standard wall functions. I do not know what were the reasons for this particular model, but in general, Realizable variant of k-ε model family is recommended, along with the so called "enhanced wall treatment". With standard wall functions, Y^+ should be in the range $30-300$ which might be difficult to satisfy in more complex geometries.

A comparison of velocity profiles at cross sections of the test section for cases with and without the grids might be useful.

There are many formal and typographical mistakes in the thesis which degrades author's work a lot. The language level is bad. The presentation of the results and discussion is not very clear. Some sentences do not make sense there.

Evaluation: sufficient (E)

Questions

- Did you evaluated Y^+ values on the walls? What is the range of their values and how do they meet the recommended values to properly capture steep velocity gradients near walls?
- Could you illustrate how the grid analysis could be done for some of the quantities in Tables 4.2 – 4.5?
- Where is the *analysis table value* mentioned on pages 43 and 48? Did you use same values when comparing the cases with and without the grid at the nozzle outlet?
- What is the meaning of *flux density* mentioned in the last paragraph of Results and Conclusions?

Prague, 16.6.2019 doc. Ing. Karel PETERA, Ph.D.