Wrocław University
of Science and Technology

CFD Simulations of Power Generation Units

Title

Organizing classes - Timetable, Assessment Criteria for Reports, Preparing a CFD Analysis Report, Editorial recommendations

Wrocław 2024

Timetable

Form of Classes - Laboratory		Number of Hours
Lab1	Organizational matters. Introduction to the course. Presentation of the tools used. Thermodynamic model of an energy installation. Preliminary analysis of the system operation.	2
Lab2, Lab3, Lab4	Flow through an insulated pipe. CHT calculations, calculations of heat losses and local pressure drops, exergy loss calculations. Influence of the numerical grid and simulation assumptions on calculation results and computational costs.	6
Lab5	Presentation of calculation results, data processing and report preparation. Creation and use of automatic data processing scripts.	2 (Report 1)
Lab6, Lab7, Lab8, Lab9	CFD calculations of the heat exchanger. Generation of the base geometry of the exchanger and its mesh discretization. CFD calculations and presentation of results. Exergy loss analysis.	8
Lab10, Lab11	Parametrization of the heat exchanger dimensions. Optimization of the heat exchanger design in terms of entropy production. Report preparation.	4 (Report 2)
Lab12, Lab13	CFD calculations of the heater/cooler. Generation of the geometry and its discretization. Numerical calculations including radiation. Report preparation.	4 (Report 3)
La14, La15		4
	Total Hours	30

Assessment Criteria for Reports

Name of Element	**What it should contain**	**Number of Points**
Title Page	1) Correctly filled-in data	0-1
Table of Contents	1) Correctly inserted table of contents	0-1
Introduction	1) Purpose of the exercise 2) Description of the subject of the report 3) Diagram of the problem illustrating boundary conditions (or physical phenomena considered)	0-1 0-3 0-5
Numerical Model	1) Diagram with marked geometry dimensions 2) Drawings showing the construction of the numerical mesh and its details 3) Description of the numerical model (used settings and models and their description) 4) Diagram with designations of surfaces used in the model 5) Boundary and initial conditions 6) Convergence conditions	0-1 0-3 0-10 0-1 0-4 0-4
Results and Discussion	1) Description of what is seen in the figures 2) Interpretation of results visible in the figures, tables, etc. 3) Comparison with literature, theory, or experiment (if possible)	0-5 0-10 0-10
Summary and Conclusions	1) Summary of the work, what was done 2) Presentation of at least 3 conclusions that can be drawn after the exercise	0-4 0-9
Literature	1) A numbered list of references used in preparing the report, enclosed in square brackets	0-2
Aesthetics of Report Execution	1) Equation numbering 2) Table numbering 3) Figure numbering 4) Text justification 5) Presentation of results (clear legend, domain settings, etc.) 6) Avoidance of widows and orphans in text	0-1 0-1 0-1 0-1 0-1 0-1
TOTAL		80

Tab. 1 Elements of the report that are evaluated

Preparing a CFD Analysis Report

Introduction

1. In the introduction, present:

- the essence of the studied issue,
- the purpose of the study,
- the physical phenomena considered in the analysis,
- the scale of physical parameters and the geometric dimensions of the installation.

2. Prepare relevant illustrations and sketches:

- mark the most important boundary conditions, parameters, and comments,
- ensure that the text on the illustrations is close in size to the report text,
- all figures and tables should be numbered and explicitly referenced in the text.

Model Assumptions and Boundary Conditions

The report should contain complete data and descriptions of procedures, allowing for the reproduction of results. Therefore, describe in detail:

1. Type of simulation (steady-state, transient)

- time step

2. Computational domains:

- material properties (provide assumptions regarding the working fluids and the source of thermophysical properties),
- description of the equations solved in the model (e.g., mass, momentum, energy conservation equations),
- computational methods used, difference schemes, turbulence, and heat exchange models,
- additional assumptions (e.g., the influence of an external gravitational field).

3. Boundary conditions:

- type and location of all boundary conditions and their indication on the illustration,
- details regarding assumptions and parameters.

4. Initial conditions

5. Selection of iterative convergence criteria: setting residual levels and choosing additional variables important for the problem, which are monitored during calculations (monitor points).

Numerical Mesh Description

1. Present illustrations showing the numerical mesh used in the studies (views, cross-sections, details). Describe its type, the number of elements, and computational nodes, as well as the average and minimum quality.

2. Present assumptions and results of the analysis of the mesh density's impact on simulation results. Use graphs and tables to show the variability of selected results depending on the applied mesh. Justify the choice of the final numerical mesh.

Presentation and Discussion of Results

1. Present pressure, velocity, temperature distributions on selected surfaces and/or cross-sections in the form of contours.

- ensure proper units and legend formatting.

2. Visualize the flow using streamlines or velocity vectors.

3. Present required graphs and tables. Describe the results shown, compare data series, and interpret the results.

Summary

1. Show which research goals were achieved.
2. Describe the impact of the analyzed parameters on the selected results.
3. Present 3 main conclusions you drew from the analyses.

Editorial recommendations

1. Margins: top, bottom, left, right - 25 mm
2. Font: Times New Roman 12 pt.
3. Text justified with single spacing
4. CHAPTER TITLES: Times New Roman 14 pt, CAPITALS bold
5. SUBCHAPTER TITLES: Times New Roman 12 pt, CAPITALS bold
6. Second-order subsection titles, if any: Times New Roman 12 pt bold
7. Numbered tables, table title centrally above the table, Times New Roman 12 pt font, 12 pt space from the body text above and below the table
8. Figures numbered, captions centrally under the figures, Times New Roman 12 pt, 12 pt spacing from the body text above and below the figure
9. Mathematical and physical equations - centrally, numbering given in brackets (....) aligned to the right margin
10. Literature sources (including Internet addresses) collected in the form of a numbered list, cited in the text by placing the item number on the list in parentheses [...].
11. All tables, figures and literature sources included in the paper must be referenced in the text of the paper
12. The structural layout of the work:
    - Title page
    - Table of contents
    - Contents of the work:
      (a) Introduction
      (b) Numerical model
      (c) Results and discussion
      (d) Summary and conclusions
      (e) Literature