FAKULTA STAVEBNÍ ČVUT V PRAZE

OPINION OF THE THESIS OPPONENT

Author of the thesis:	Bc. Joaquín Rodrigo Llanos Espinoza
Title of thesis:	Mathematical Modelling of Solid-Liquid Flow in Open Channel
Master thesis opponent:	Dr. Ing. Petr Nowak CTU, Faculty of civil engineering Department of hydraulic structures

Thesis evaluation criteria:

1. Meeting the requirements of the assignment: *Evaluation:* (B)

The assignment is understandable and fully defined. There are no suggested ways of solving the problem. In principle, it is a mathematical modelling of a very complex phenomenon. The graduate has treated the topic, some areas have been covered in unnecessary detail (especially the direct Fluent setup and theoretical introduction) and minor areas of the assignment have not been covered (e.g. mobile bed model).

2. Methodology and logical structure of the thesis: *Evaluation: (*C)

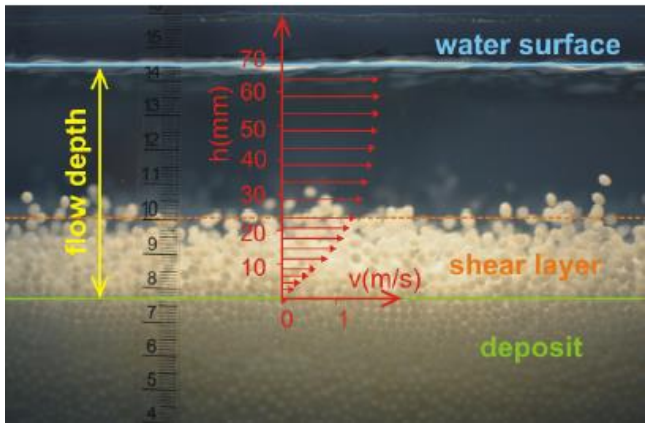
In the introductory part there is a detailed theoretical description of possible modelling principles. However, a precise description of the objectives and the choice of the most appropriate means of simulation is missing. For easier understanding, I would prefer to first define the phenomenon to be mathematically modelled, determine the important and negligible influences. Only then to discuss the theory that directly relates to the physical phenomenon being simulated.
The assignment allowed a comparison between the physical (Matoušek 2015) and mathematical models, which is an excellent opportunity for the student. I recommend summarizing the measured data at the beginning, define the quantities that will be compared with CFD results after simulation is made.
If the goal was CFD simulation of the phenomenon studied in the physical model, the consideration of the initial condition is missing. The formation of a stable deposit near the bottom may exhibit considerable hysteresis with a fixed-bottom flow regime. These considerations are very complicated but fundamentally affect the phenomenon under study.

3. Quality of processing of results: *Evaluation:* (B)

I am not informed whether and what kind of professional support the student had during the processing. As this is a mathematical modelling of an extremely complex physical phenomenon, I consider it necessary to build on previous work and only refine and verify the results. If the student started the work from scratch, I consider the quality to be very good. In this case, I consider it appropriate to deal only with a narrow, simple and clearly defined phenomenon that has been laboratory verified.

4. Interpretation of results, discussion: *Evaluation:* (B)

The accuracy of the interpretation is related to a very broadly defined task. I do not have practical experience in the field of "sediment transport", because I see applications in hydropower specialization only in sand traps on inlet objects or siltation of waterways. If I assume that the aim of the paper was to simulate a physical phenomenon that was investigated in the laboratory (see illustration photo), the conclusions of the paper are overstated.



In the conclusion of the paper there is no evaluation of the differences between the physical and mathematical model in the form of photo documentation, vertical sections graphs with plotted velocities, concentrations, water levels etc.. The assigned task is so complex that its completion will require years of very demanding work.

5. Use of literature and citations: *Evaluation:* (B)

The list of used literature points mainly to the study of the physical nature of the given phenomenon, but not to the means of mathematical simulation. Personally, I would give more weight to a search of already built and validated sediment transport models and CFD models that are able to capture these phenomena at least to a limited extent. The breadth of the problem, from theory to the execution of simulations, is far beyond the time available for a thesis.

6. Formal arrangement of the thesis, graphic and linguistic level: *Evaluation:* (-)

The form of the work is appropriate, I cannot comment on the language level because my knowledge of English is limited.

7. Conclusions of the thesis and their formulation: *Evaluation:* (C)

The conclusion of the paper is too detailed and lacks the perspective that would allow the student to highlight their main achievements. I consider the evaluation of the constructed mathematical simulation of the phenomenon in comparison with the physical model to be insufficient. The conclusion of the thesis should include a list of recommended improvements and procedures for future work.

8. Questions for the defence and any further comments on the thesis:

I would like to ask a few questions:

- How many cells did the computer network have?
- On page 51 there is a reference to air humidity with reference to the concentration of air in water. In your opinion, does air humidity have a significant effect on the physical phenomenon under investigation? Was the gaseous phase air "mixed" into the water at the inlet, or what is the physical significance of this?
- How do you explain the very superficial drop in air concentration in the vertical section (e.g., Figure 4-3 on page 64)?

Overall evaluation of the thesis*:

I recommend the thesis for defence: YES Proposed grade: (B)

***In accordance with the provisions of Section 47b of Act No. 111/1998 Coll., on Higher Education, as amended, the Czech Technical University in Prague publishes the thesis, including the opinions and the record of the course and result of the defence, on a non-profit basis. By submitting the report, the opponent agrees to its publication.*

Prague, 14th June 2024

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Signature of the opponent