Univerzita Tomáše Bati ve Zlíně
Fakulta technologická

ÚSTAV VÝROBNÍHO INŽENÝRSTVÍ

DISSERTATION REVIEW

Author: Ing. Lukáš Gregor

Title: OPTIMISATION OF MOTORCYCLE FRAME FROM COMPOSITE MATERIALS CONSIDERING MANUFACTURING TECHNOLOGY

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Reviewer: doc. Ing. Soňa Rusnáková, Ph.D., Faculty of Technology, Department of Production Engineering, Vavrečkova 5669, 760 01 Zlín

The presented doctoral thesis deals with the optimization of the structural design of a frame made from composite materials for use on motorcycles with a hybrid drive. The problem addressed is topical with a direct impact on technical practice. Currently, there is a high demand for the application of CFRP in the construction of vehicles in general, from aerospace to rail vehicles.

The doctoral thesis consists of 116 pages, 10 main chapters, including the contribution to science and practise.

The aims od the thesis are formulated clearly. The dissertation is generally divided into two main parts, the state of the art and the experimental section.

The state of art defines composite materials, modern optimisation methods, design requirements for a motorcycle frame and analysis of the baseline design.

The chapter manufacturing technology describes manufacturing of composite parts, including creation of design and preparation, overview of master model fabrication, mould fabrication, their surface treatment, the production itself. The student visualizes the fundamental structural components of the monocoque, which are the nearly symmetrical right and left halves. The final stage of manufacturing involves the bonding of all composite and aluminium components into a complete structural monocoque.

Two auxiliary components were integrated into the monocoque design, both of which fulfil multiple functions in addition to their structural role. The components are a cooling duct and battery stop. The moulds for these components were produced by 3D printing from PC material. The chapter material properties and data validation describes the determination of the fundamental mechanical properties of the biaxial reinforcement and woven fabrics used in the study.
To validate that the numerical simulations converge towards reality, a technological specimen was employed which was both structurally and technologically very similar to the investigated frame.
The outcome of the chapter 5 Topology optimisation is not a final geometry but rather a conceptual material layout that indicates how the structure should be shaped to utilise the material as efficiently as possible. This approach is widely applied in the aerospace, automotive, and mechanical engineering industries.
The last two chapters deals with design and technological optimisation and with the numerical analysis of monocoque structures.
The author refers to 79 relevant references to scientific literature in the doctoral thesis, which indicates his good preparation for solving the chosen problematic. I also evaluate very positively the author's own publication activity with the indexing of the contribution in the WoS database and publications presented at international conferences focused on the researched issue. It is obvious that the author actively participates in scientific conferences.
The goals of the dissertation were met and demonstrated the ability of the doctoral student to achieve them using appropriately chosen methods and procedures.

<u>I have the following ideas and comments for the discussion:</u>

1) *Why did you choose for joining of two halves of monocoque the process of gluing? Which other methods/process/technologies should be useable? Compare the advantages and disadvantages of both possible joining methods.*

2) *Can you present the lay-up manual and individual pictures from composite parts manufacturing, including overlaps, orientations of individual layers or reinforcement. I miss the detailed description of manufacturing process.*

3) *The drawing or schematic dimension of parts missed in the thesis; can you specify the thickness, dimension, radii and construction/technological requirements for monocoque?*

4) *On the page Nb.47. you describe the used curing cycle according to the data sheet, but I didn't find the commercial producer or data sheet of this prepreg. Ň*

5) *Can you show the Report from the autoclave curing, including the set-up parameters, real achieved parameters during curing? By which method was the curing process managed and why?*

6) *On page Nb. 59. you describe that the tested specimens were manufactured from twill woven fabric with and biaxial prepreg. Why you combine the dry fabric with the prepreg?*

7) *Chapter 3.1.3 Mould fabrication generally describes the fabrication process. I miss the reason which material you used for the production (I guess composite tool). Can you specify the tooling prepreg and schematic lay-up manuals which you used during the own mould manufacturing.*

The reviewed dissertation meets the required professional standards and brings the original findings leading to several practical applications. Through this own work, the doctoral candidate has demonstrated technical expertise and the ability to work independently and creatively.

Therefore. I can conclude that the submitted dissertation fulfils the conditions as stipulated in § 47 of the Higher Education Act No.111/1998 Cool.

I therefore recommend the reviewed work for defense. In case of a successful defense, I recommend that Ing. Lukáš Gregor be awarded the academic degree of Ph.D.

Zlín 17. 11. 2025 doc. Ing. Soňa Rusnáková, Ph.D.