Opponent's Report on Doctoral Thesis

Title: Critical length parameter used for fatigue lifetime predictions of notched specimens
Institution: Institute of Solid Mechanics, Mechatronics and Biomechanics, Faculty of Mechanical Engineering, Brno University of Technology.
Author: Ing. Kamila Kozáková
Supervisor: doc. Ing. Jan Klusák, Ph.D.
Reviewer: doc. Ing. Libor Trško, PhD.

1. Relevance of the selected topic:
The topic of fatigue life prediction is very relevant as the innovation cycle of engineering devices has been significantly shortened in the recent decade. This narrows down the possibility of performing long-lasting conventional fatigue tests and proper theoretical fatigue life assumption provides highly appreciated time and cost savings.

2. Achievement of the set dissertation objectives:
The set of theoretical and experimental objectives were fully fulfilled.

3. Problem-solving approach and contributions of the doctoral student
The solving of the dissertation objectives is highly systematic, and all methods are carefully chosen to provide the required information and answers. The design of total seven types of specimens and the extent of the fatigue tests performed on six different materials shows the tremendous amount of work the candidate needed to complete to obtain proper input values for the notch effect analysis via theory of critical distances.

4. Significance of results for industry and development of the scientific field
The main message of the dissertation is the extension of the theory of critical distances for notch effect analysis for structural materials loaded in the high and mainly ultra-high cycle region. The theory was verified on six different structural materials, which included one aluminium alloy, two stainless steels and three structural steels with different microstructures. Unnotched and six types of notched specimens, with notch radii ranging from 0.1 mm to 3 mm, were carefully designed to meet the resonance condition and consequently subjected to ultrasonic fatigue loading at 20 kHz frequency. To my knowledge, the outcome of the test plan is one of the largest datasets mapping the influence of notch geometry on various structural materials recorded for ultrasonic fatigue testing, therefore the S-N curves provide valuable results for component designs in industrial engineering companies. Further on, critical distances were evaluated, and when only a constant value was used for fatigue life prediction, the correlation with the existing experimental data was low. Predictions were improved by using critical distance dependance and further on, the author used own modified critical distances, which overall gave the best achieved correlation. Even though, not even after the modification, an ideal match was observed for all materials, the approach showed the strengths and weaknesses of the theory and significantly contributed to development of the methodology.

5. Formal and linguistic editing
The thesis is carefully and neatly written without typographical errors. Figures and captions are well designed and readable.

Univerzitná 8215/1, 010 26 Žilina
T: +421 41 513 7636 • M: +421 903 581 391
www.vyskumnecentrum.sk

ID: 00397563
Tax ID: SK 2020677824
DIČ: 2020677824

6. Shortened version of dissertation thesis

The shortened version of dissertation is well prepared and contains all the required sections. Overall, it provides good overview of the dissertation in both, theoretical introduction and highlights of the achieved results. Only the "Contents" needs to be updated as it is missing the "Conclusion" section.

7. Questions related to the dissertation thesis

I would kindly ask the candidate to answer the following questions related to the dissertation:

1. How do you explain the difference between the S-N curve of 304 stainless steel in Fig. 1.11 and your results given in figures 3.13 and 3.14. What do you consider the most challenging aspect of fatigue testing of austenitic stainless steels?
2. When fatigue crack is initiated in the test specimen, the frequency of the testing system changes rapidly, typically causing the system to fall out of resonance. This means that the crack stops propagating after a very short length is reached. How can you explain that multiple fatigue cracks were able to initiate prior to losing the resonance?

Conclusion

Ing. Kamila Kozáková is a co-author of 10 scientific articles indexed in the Web of Science database with the H-index of 4. This underlines the systematic work of the candidate and that the results are of interest in the scientific community. The submitted thesis entitled *"Critical length parameter used for fatigue lifetime predictions of notched specimens"* fulfills all the requirements of dissertation theses and **I recommend awarding the candidate with the academic degree of "Ph.D."** after a successful defense.

In Žilina, 19th of August, 2025

doc. Ing. Libor Trško, PhD.