Opponent's Opinion of the Dissertation

Approximate Methods for Calculating Notch Tip Strains and Stresses under Multiaxial Cyclic Loading

by Ing. Maxim LUTOVINOV

Supervisor: prof. Ing. Milan Růžička, CSc.

Opponent: doc. Ing. Martin Fusek, Ph.D.

Content of Work

The presented dissertation thesis deals with approximation methods for the calculation of elasto-plastic strains and stresses on the surface of the notch root. A new procedure was proposed which was subsequently verified on own and adopted experimental data.

State of the Art

The analysis of the current state of knowledge related to the topic is mainly dealt within chapter two. This part of the thesis is brief, however, all the necessary information on the subject is given and it is based on a sufficient number of literature sources.

Fulfillment of Work Goals

The aim of the dissertation thesis and the individual sub-objectives were specified in chapter three. The main objective of the present work is the development of a new pseudo-curve-based approximation method for the determination of elastic-plastic stress and strain during multiaxial cyclic loading. This main objective is fulfilled sequentially in three sub-steps: 1. developing a methodology to combine the correction for the effect of the notch with the plasticity model, 2. designing a new approximation method, and 3. measuring the data (performing an experiment) to obtain the data for validation of the proposed approach.

I conclude that all the stated objectives of the dissertation have been fulfilled to the fullest.

Theoretical Contribution of Thesis

The main theoretical contribution of the work is the proposal of a new approximation method combining the effect of the notch and the plasticity model (here the Abdel-Karim-Ohno model) to determine the correct value of elastic-plastic stress and strain at the root of the notch based on the elastic solution in the case of multiaxial cyclic loading. This modern approach proved to

be suitable in the test case with good agreement with experimental data. However, as the author of the paper rightly states, there is a need to further develop the obtained knowledge and to implement other parameters in the determination process, namely non-proportional hardening, which will help to describe the behavior of strengthening materials.

Practical Contribution Thesis

The practical benefits of the work clearly include the creation of custom code for the application of the author's approximation method. The actual script is published in the appendix of the thesis and thus available to other researchers for application or future research.

A major contribution can also be seen in the execution and evaluation of the experiment on notched samples made of 2124-T851 material, where a total of 18 different loading paths were used. These data are undoubtedly a beneficial part of the results of this work.

The Appropriateness of Solution Methods Used and How They Have Been Applied

There are no comments on the solution methods and their application.

Whether the doctoral student has demonstrated adequate knowledge in the field

It is evident from the submitted text that the author is a specialist in the subjected area and has demonstrated sufficient knowledge not only in that field. The qualities can also be inferred from the doctoral student's publication activity, where he is the author or co-author of 6 publications.

Formal level of work

The thesis is written in English on a total of 105 numbered pages. The actual text of the thesis is contained on the first 65 pages, the remaining parts of the thesis are taken up by appendices. The chapter titles and the overall structure of the thesis are well designed. The text is supplemented by a sufficient number of figures and tables. The actual content of the appendices appropriately complements the overall text of the thesis (own data, program listing). Literature is appropriately cited. There are no significant comments on the language.

Questions for the student

There are no information about parameters of the material model in the dissertation thesis (with the exception of the parameter influencing the ratchetting). Only a reference to the estimation code in the appendices is stated. How many kinematic parts M (5) were used? What parameter values were used for each curve?

Final Assessment and Statement

I state that the objectives defined for the submitted dissertation have been fully met. The thesis also meets the formal requirements for a dissertation. The author of the thesis has demonstrated theoretical and practical abilities, as well as the ability to independently carry out scientific activities and thus contribute to the development of the scientific field. On the basis of the above, I recommend the thesis for defense, and after its successful completion to award Mr. Ing. Maxim Lutovinov with a Ph.D. degree.

Ostrava, 18 May 2022

doc. Ing. Martin Fusek, Ph.D.

VŠB – TU Ostrava, Fakulta strojní
Katedra aplikované mechaniky
17. listopadu 2172/15
708 00 Ostrava – Poruba