CZECH TECHNICAL UNIVERSITY IN PRAGUE
Faculty of Civil Engineering
Department of Science and Research
Thákurova 7, 166 29 Praha 6

e–mail: obhajoby@fsv.cvut.cz tel.: 2 2435 8736

Opponent's review of the Doctoral Thesis

Candidate Ing. Jan Jůza

Title of the doctoral thesis Global analysis of stainless steel portal frames

Study Programme Civil Engineering

Tutor Prof. Ing. Michal Jandera, Ph.D.

Opponent Prof. Ing. Zdeněk Kala, Ph.D.

e-mail Zdenek.Kala@vut.cz

Topicality of the doctoral thesis theme

Commentary: The Ph.D. thesis addresses the global analysis of stainless steel portal frames, which is a highly relevant topic in the context of modern structural engineering. With increasing demands for material properties, structural reliability, and sustainability, stainless steel has emerged as a key material due to its excellent mechanical characteristics, such as high ductility, significant strain hardening, and good fire resistance. However, despite these advantages, the available experimental data on entire stainless steel structures remain limited. This thesis contributes significantly to filling this gap by conducting extensive experimental tests and advanced numerical analyses. The proposed methods and findings offer valuable insights into the behavior of stainless steel structures, particularly regarding the effects of material nonlinearity on global structural behavior. Given the need for more accurate design models for stainless steel structures, the theme of this thesis is timely and of high importance to both academic research and practical applications in structural engineering.

☒ excellent	☐ above average	☐ average	☐ below average	☐ poor

Fulfilment of the doctoral thesis objectives

Commentary: The aim of the research is to increase the understanding of the global behavior of stainless steel portal frames using empirical testing and sophisticated numerical simulations. The candidate successfully achieves these objectives by conducting comprehensive experimental testing of several stainless steel frames and developing advanced numerical models to simulate the observed behaviors. The numerical simulations were validated against experimental results, and the findings were further extended through parametric studies. Additionally, the proposed modifications to design approaches demonstrate a strong application of theoretical knowledge to practical design challenges. The thesis not only meets but also exceeds its stated objectives by providing valuable contributions to both the academic understanding and practical implementation of stainless steel structural design.

☒ excellent	☐ above average	☐ average	☐ below average	☐ poor

Research methods and procedures

Commentary: The research methods used in Ph.D. theses are suitable for the complexity of the investigated problem.The candidate combines both experimental and numerical approaches, creating a robust framework for exploring the nonlinear behavior of stainless steel portal frames. The experimental procedures are clearly described, including the setup of load tests on stainless steel frames, which are critical for validating the accuracy of the numerical models. The thesis also demonstrates the use of advanced numerical techniques, such as finite element analysis, which allows for detailed parametric studies and the exploration of various structural behaviors under different conditions. The integration of experimental validation with numerical simulations enhances the credibility of the research, ensuring that the findings are grounded in both practical observations and theoretical rigor. Overall, the research methods and procedures are meticulously designed and executed, reflecting a high level of proficiency in both experimental work and computational analysis.

☒ excellent	☐ above average	☐ average	☐ below average	☐ poor

Results of the doctoral thesis – dissertant's concrete achievements

Commentary: The Ph.D. thesis offers significant contributions in the areas of imperfection analysis, design standards, verification of Eurocode, and the development of advanced numerical models, focusing primarily on the nonlinear behavior of stainless steel portal frames. One key result is the identification of discrepancies between the Eurocode's design procedure and the observed behavior of stainless steel frames. The dissertant proposes an increase in sway imperfection values, supported by both experimental testing and validated numerical simulations, leading to a more accurate design procedure that better addresses nonlinear material behavior. The parametric study refines the understanding of the effects of imperfection on structural performance. Moreover, the comparison of numerically derived capacities with Eurocode predictions revealed consistent overestimations, prompting suggested modifications to the design standards. These findings were validated through experimental load tests on stainless steel frames. However, while the thesis provides robust insights and practical improvements, there is no significant mention of stochastic models or related statistical approaches, particularly in modelling material or geometric characteristics as random quantities. Incorporating such methods could have added another step of analysis, providing a more comprehensive treatment of uncertainty in structural behavior. Still, the work presents valuable and substantial contributions to the field of structural engineering.

☐ excellent	☒ above average	☐ average	☐ below average	☐ poor

Importance for practice and for development within a branch of science

Commentary: The Ph.D. thesis advances the understanding of stainless steel portal frames, a subject that has been less explored compared to carbon steel structures. Stainless steel's unique nonlinear stress-strain behavior requires a different approach to design and analysis, which the thesis addresses by proposing modifications to Eurocode. These modifications, particularly regarding the treatment of sway imperfections and second-order effects, directly impact the practical design of stainless steel frames. By refining these design models, the work improves structural safety and efficiency, especially in light of the material's tendency for strain hardening and greater deflection under load. On the scientific front, the thesis fills a critical gap by conducting parametric studies and developing advanced numerical models that accurately simulate both geometric and material nonlinearities in stainless steel structures. The validation of these models against experimental results demonstrates their applicability in real-world scenarios, providing a solid foundation for future research.

☒ excellent	☐ above average	☐ average	☐ below average	☐ poor

Formal layout of the doctoral thesis and the level of language used

Commentary: The formal structure of the Ph.D. thesis is well-structured and follows a logical progression, making it easy to navigate through the chapters and sections. The organization of experimental work, numerical modeling, and analysis is clear, with appropriate use of figures and tables to support the text. Regarding the language, the thesis is written in a high level of academic English, with correct terminology and a formal tone. The clarity of expression and consistency in style contribute to the overall readability and professionalism of the document.

☒ excellent	☐ above average	☐ average	☐ below average	☐ poor

Statement on compliance with citation ethics

The Ph.D. thesis has been examined for compliance with citation ethics using Theses.cz and iThenticate (Turnitin). The review identified matches between the thesis content and the author's published articles in academic journals. While these sources were not cited directly within the text, the identified overlaps are related to the author’s own previously published work. Additionally, both systems found small matches in short text fragments and the bibliography. These minor overlaps do not constitute a fracture of citation ethics. Therefore, the overall conclusion is that there are no concerns regarding compliance with citation ethics in the Ph.D. thesis.

Remarks

The Ph.D. thesis demonstrates a solid understanding of the analysis and modeling of stainless steel frames. However, I have a question regarding the use of average yield strength and characteristic yield strength in the research. Specifically:

In your thesis, you mention the use of average yield strength and characteristic yield strength in analyzing the behavior of stainless steel structures. Can you explain the difference between these two values in terms of their use in numerical models and design calculations according to Eurocode? How does the choice of these parameters affect the accuracy of your numerical simulations for both slender and non-slender structures and their calibration against experimental data?

Final assessment of the doctoral thesis

The Ph.D. thesis of Ing. Jan Jůza offers substantial contributions to the study of stainless steel structures, particularly in the context of global analysis and design improvements. The candidate has met the objectives of the research, providing a detailed investigation into the behavior of stainless steel frames and proposing relevant modifications to existing design codes. While there are areas where the research could be expanded, such as the incorporation of stochastic approaches, the thesis fulfills the necessary criteria for a Ph.D. degree. Following a successful defense of the thesis, I recommend the granting of the Ph.D. degree.

Following a successful defence of the doctoral thesis I recommend the granting of the Ph.D. degree

yes ☒ ***no*** ☐

Date: 10 October 2024

Opponent’s signature: ....