

Opponent's review of the Doctoral Thesis

Candidate Ing. Abhishek Ghimire

Title of the doctoral thesis NUMERICAL CALCULATION OF WELDS IN STRUCTURES FROM HIGH-STRENGTH STEEL

Study Programme Doctoral study programme: Civil Engineering Branch of study: Integral Safety

Tutor Doctoral thesis tutor: prof. František Wald, CSc

Opponent prof. Tomasz Jankowiak

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Topicality of the doctoral thesis theme

Commentary: The topics considered in the doctoral dissertation are current and consistent with the latest problems in construction and civil engineering. The work mainly concerns numerical calculations used to design welded joints of steel structures made of high-strength steel. The work has 125 pages and is divided into 10 chapters and additional chapters such as literature, annexes (8) and lists of figures and tables. The structure of the thesis is very good in my opinion.

excellent above average average below average poor

Fulfilment of the doctoral thesis objectives

Commentary: In point 3, the candidate discusses the objectives of the doctoral dissertation, including: goal-1: "Test and validate the design model using experimental, analytical, and finite element results". goal-2. "Investigate the deformation capacity of HSS transverse fillet lap welds." and other second order goals. In the following chapters the candidate conducts an in-depth analysis of the proposed methods, which leads to the achievement of research objectives. In my opinion, the candidate discussed and solved the problems presented to him very precisely, combining various research methods: experimental and numerical or analytical.

excellent above average average below average poor

Research methods and procedures

Commentary: After a detailed review of the subject literature and after setting the goals of the doctoral dissertation, the candidate used several research methods: experimental, analytical and numerical in order to implement the set tasks. In his dissertation, the doctoral student presented experimental research carried out as part of the TAČR Merlion III FW01010392 research project at the Department of Steel and Wooden Structures of the Czech University of Technology in Prague. He explains the specimen geometry, material details, test execution process, and test results. He also discussed the analytical model (AM) of a transverse fillet welded joint made of HSS steel along with the analytical calculation of the weld load capacity, which is then compared with the results of the numerical computational model. He also conducted detailed numerical research using the finite element method. He analyzed the use of shell and solid models in calculations. He solved a number of important computational examples in which he analyzed the behavior of welded joints. The important part of the thesis was the verification of the results obtained.

<input type="checkbox"/> excellent	<input checked="" type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor
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Results of the doctoral thesis – dissertant’s concrete achievements

Commentary: The topic of the dissertation is constrained to fillet lap-welded connections. It focuses on determining weld resistance design for transverse and longitudinal fillet lap-welded connections using high-strength structural steel (HSS). Employing a finite element model named the regular inclined shell element model (RISEM), a novel strength criterion is proposed based on stresses on inclined shell elements. This criterion utilizes maximum uniform equivalent stress as an indicator and applies standardized procedures for joint design using the Finite Element Method (FEM). The study demonstrates that the numerical calculation for weld design resistance can be achieved by considering only three primary parameters (E, fy, and fu) without conducting material tests in the FE model, thereby limiting plastic strain. Comparative analysis reveals that RISEM results are more cost-effective than those obtained from analytical models for both welded configurations, with transverse welded resistance being 1.6 times higher. The proposed design model emphasizes the importance of considering the economic aspect of connection design and advocates for conducting reliability analysis based on current findings. Furthermore, it underscores the necessity of exploring reliability and probability studies in this context.

<input type="checkbox"/> excellent	<input checked="" type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor
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Importance for practice and for development within a branch of science

Commentary: The research results presented in the dissertation can be used directly by designers and construction engineers. This study can be used in my opinion to better and more effectively design of the transverse and longitudinal fillet lap-welded joints in elements made of high-strength structural steel (HSS).

<input type="checkbox"/> excellent	<input checked="" type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor
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Formal layout of the doctoral thesis and the level of language used

Commentary: The work was written carefully in English. Contains correctly and clearly presented pictures and tables. In my opinion, excluding side topics that constitute supplementary material is beneficial. This makes the analysis and discussion of the problems shorter and more precise.

<input type="checkbox"/> excellent	<input checked="" type="checkbox"/> above average	<input type="checkbox"/> average	<input type="checkbox"/> below average	<input type="checkbox"/> poor
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Statement on compliance with citation ethics

In my opinion, the author of the dissertation referred to the sources appropriately. He correctly quotes and discusses the achievements of other authors, including in a fairly extensive literature review (chapter 2). He showed what his contribution was to the presented research.

Remarks

In dissertation Phd student investigated the durability of fillet lap-welded connections in high-strength structural steels using analytical, experimental, and numerical methods (FEM). The author developed a reliable numerical design calculation (NDC) to evaluate the durability of fillet lap-welds in high-strength structural steel S700 MC Plus, following design standards. The Phd student showed that numerical modeling and computer simulations are of great value in the design of welded joints in structures. As a result, we obtain precise information on the state of deformation, stress state and location of permanent (plastic) deformations of these connections. This can lead to better and more accurate strength and durability, including fatigue life.

The only shortcoming of the doctoral dissertation is the lack of direct reference to the analysis of the fatigue strength of the welded joint in question. Can the discussed methods be used to determine the expected life of a connection under low- and high-cycle fatigue? What if vibrations or dynamic forces occur in the structure? What in case of fire?

Final assessment of the doctoral thesis

Overall, the doctoral thesis demonstrates a high level of scholarship, critical thinking, and research proficiency. The findings presented contribute significantly to the body of knowledge in the field of civil engineering and lay the groundwork for future research endeavors.

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

yes no

Date: 26.02.2024

Opponent's signature:
