

Dynamic fracture behaviour of high strength steels

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The thesis deals with the problems of strength and fracture toughness of various welded steels, including advanced types prospective for railway vehicles. It has 172 pages including symbols, figures and references, and is divided into nine chapters plus appendices.

The first chapter introduces briefly the topic. Chapter 2 gives a review of fracture mechanics and its testing. Chapter 3 explains the welding methods, weld defects and process simulation. Chapter 4 formulates the main objectives of the dissertation work: study of properties of a new type of steel in order to promote its wider use in railway vehicles. Chapter 5 describes the methods used for the evaluation of fracture toughness and Chapter 6 reviews the published results of the related research. Chapter 7 describes the experiments done by the doctoral student, such as welding of the selected specimens, weld simulations, and testing of hardness and fracture toughness. The most extensive Chapter 8 evaluates the obtained results. Chapter 9 summarizes all results and suggests the possible ways of future research.

The dissertation thesis ends with the list of references (62) and the list of 9 author's publications (mostly in the journals or proceedings of international conferences).

General evaluation

- a) The use of high strength steels is crucial for construction of lightweight railway vehicles. A necessary condition for their successful use is well-managed welding. The dissertation, which helps in understanding of properties and behaviour of such steels, is therefore very topical.
- b) The text of the thesis is understandable and the individual chapters are arranged in a logical way. The measurements and observations were described carefully. The text illustrates big amount of work, performed by the doctoral student very carefully.
- c) The dissertation work has fulfilled the objectives formulated in Chapter 4.
- d) There are several positive outcomes of the thesis, summarised as follows:
 - Very well prepared review of publications related to the dissertation topic.
 - Very carefully prepared and performed extensive material tests (strength, fatigue, fracture toughness including dynamic one, welding and simulated welding). All results were well described, also with SEM and fractographic analysis.
 - Better understanding of various factors influencing the properties of welded steels, especially of Strenx 700MC.
 - Improvement of the preparation of CCRB and CCNB specimens, which ensure plane strain condition at the crack tip.
 - The first use of the Crack - Depth meter.
- e) The obtained information can help in managing the use of advanced steels in vehicle technology, and thus in the reduction of their weight and increasing the technical level of railway vehicles.

f) The extent and quality of the submitted thesis (172 pages including figures, tables and references, plus the list of figures and abbreviations) and the nine published works of the applicant (related to the dissertation) are more than adequate.

g) The dissertation thesis meets the general requirements for awarding the title Ph.D.

Conclusion

I recommend that this dissertation thesis is defended, and - in positive case - that the applicant is awarded the title Ph.D. (Several questions and critical remarks, written below, should be answered during the discussion).

26th November 2018


Prof. Ing. Jaroslav Menčík, CSc.
reviewer

Questions

- 1) Can you explain briefly the relation of the CCRB and CNRB specimens to the welded specimens of the Strenx 700MC steel?
- 2) How can the Weld thermal cycle be simulated?
- 3) Can you tell something about the curve fitting by Excel in Fig. 8.21 (p. 104)? [Selection of the curve, determination of its constants and verification of its suitability.]
- 4) What do you consider as the main outcome of your dissertation work?

Critical notes

- 1) The effort make the work understandable, has caused rather long extent of Chapter 2. The tasks of the dissertation are explained not earlier than at page 48. [On the other hand, Chapter was well understandable even for those not familiar with fracture mechanics.]
- 2) The obtained outcomes could be written in a more definite way.
- 3) The text was prepared carefully, nearly without printing errors. Only the name in the table on page 53 should perhaps be Barsom, instead of Barson. In the list of references, No. 61, the venue of conference is missing.