

# Opinion of master thesis

Topic of master thesis:

## **Structural and Mechanical Heterogeneities of Fine-Grain Steel Welded Joints Used in Construction of Rail Vehicles**

Thesis author: Fatih Bozkurt

The diploma thesis is focused on research of mechanical response two steels (S355N and Domex700MC) with improved yield strength, as the prospective materials for light weight railway vehicles construction parts. The current necessity to describe their dynamic behavior after welding was the main motivation of this topic.

According the assignments of diploma thesis, the theoretical part is dealing with contemporary state and development tendency of application of higher strength steels in railway vehicles. Also next theoretical parts - overview of fracture modes, strengthening processes, their testing methods etc. are presented in suitable form and in logical connection with researched problem.

The main part of work is experimental study of welding process as an source of local structural and mechanical heterogeneity. The experimental welding using the shielded metal arc welding was performed; very important is precise description of experimental welding process and preparing of experimental samples, which enables the next research based on reached results. Chosen steels present the different primary strengthening mechanisms, so the structural and fracture analyses had to be conducted to find out the real source of degradation of dynamic resistance in the heat affected zone.

The substantial part of analytical work were the structural and phase analyses, with support of hardness evaluation of each sublayers of the heat affected zone. The core of thesis was dynamic testing of different welding joints parts - instrumented Charpy impact testing. Obtained force – displacement curves contain direct information about energy consumption during dynamic loading. Based on these analyses, the results about the stable vs. unstable crack propagation showed the different dynamic fracture resistance of the investigated state of both compared materials. The used evaluation is in accordance with current standards. This part of work was very difficult for correct interpretation of results; mainly the evaluation of dynamic test with emphasis on the connection with identified structural and fracture modes. Author demonstrated the ability of independent theoretical study for understanding of observed processes and ability of independent scientific work. Except of a few inaccurate terms, the work is without substantial mistakes.

I have the following questions towards the general interpretation of obtained results:

- 1) Which experimental evaluation is suitable as a next step of research, towards the effective determination of local mechanical heterogeneity?
- 2) What is the most common source of primary mechanical heterogeneity of used steels?

### ***Overall evaluation***

The diploma thesis assignments has been fulfilled. The reached results are applicable in practice, as a base information towards the prospective application new steels according the new construction requirements, and also as the fundament for next research.

I recommend master thesis of Fatih Bozkurt to defend with the evaluation degree  
“**excellent**”.



Pardubice, 2.6.2015

prof. Ing. Eva Schmidová, Ph.D.