

UNIVERSITY OF ŽILINA IN ŽILINA  
Faculty of Mechanical Engineering  
Department of Materials Engineering

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# SEMDOK 2013

18<sup>th</sup> International of PhD. students' seminar

under the auspices of  
prof. Dr. Ing. Milan Sága  
dean of the Faculty of Mechanical Engineering of the University of Žilina in Žilina



Terchová, Slovakia  
30 January – 1 February, 2013

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## INFLUENCE OF STRESS CONCENTRATION ON MECHANICAL PROPERTIES OF HIGH STRENGTH LOW ALLOYED STEEL GRADE

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### Abstract

*The analysis of stress concentration influence to mechanical properties at high strength steel grade is considered in this paper. Experimental testing was done on specimens with different radius of the U-shaped circumferential groove in a bar of circular cross section made of S690QL high strength low alloyed steel in static load condition. The influence of stress concentration to mechanical properties is analyzed by correlating of yield stress limits and maximal stress limits obtained for different stress concentrations due to variation of radius of the U-shaped circumferential groove and related limits obtained at same specimens without stress concentration. The numerical models were developed by finite element method for each type of specimens and related results, obtained by numerical simulations, are correlated. Yield stress limits and maximal stress limits obtained by experimental and numerical approach are compared in order to verify the usage of numerical simulation methods on elements made of high strength low alloyed steels. On the basis of the obtained results it is implicated that*

### 1. Introduction

Due to advanced properties, especially very favorable combination of strength and ductility, high-strength steels provide higher flexibility during design process, but must be considered differently from the conventional steels, which they replaced. The characteristics and properties of high strength steels in exploitation are, on the other hand, the result of their microstructure and additional factors. The number and complexity of those factors that influence characteristics and properties of the construction in exploitation imply that those characteristics can be determined only by experimental testing in real exploitation conditions. Stress and strain distributions are determined by stress concentration caused by geometrical discontinuities and heterogeneity of material. Stress concentration changed the stress distribution, position of maximal stresses and, by that, the position of the critical cross section zone, which acts both as damage and integrity safety risk. The stress state of the mechanical construction elements, made of high strength steel, in exploitation, is complex and it resulted from number of various factors. The characteristics of those constructions and their response to load are, besides of factors related to their microstructure also influenced by factors related to their stress-strain state. The sensitivity of this steel to stress concentration is the major factor that defines the construction response to loads as well as its mechanical properties.

### 2. High-strength low alloyed steels

High-strength steels were developed and produced in order to improve the mechanical characteristics and resistance to corrosion in relation to conventional carbon steel grades. They are selected based on the minimal required mechanical properties, while the producers





