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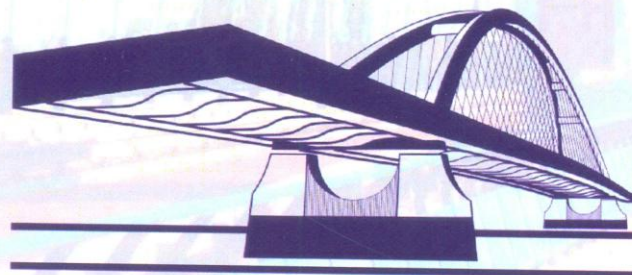
Faculty of Civil Engineering  
Department of Structures and Bridges



# **STEEL STRUCTURES AND BRIDGES 2012**

23<sup>rd</sup> Czech and Slovak International Conference

## **EXTENDED ABSTRACTS**



September 26 – 28, 2012, Hotel Permon, Podbanské, Slovakia

### **ORGANIZED BY**

**Department of Structures and Bridges**  
University of Žilina, Faculty of Civil Engineering

### **IN COOPERATION WITH**

Slovak Association of Steel Construction  
Czech Constructional Steelwork Association



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**September 26-28 2012, Hotel Permon, Podbanské, Slovakia**

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## Estimates of weldability and selection of the optimal procedure and technology for welding of high strength steels

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**Keywords:** High strength steel S690QL (EN 10025-6); weldability; welding technology; microstructure; toughness.

High strength steels belong into a group of high quality steels, with exceptional mechanical properties, especially in regards to tensile strength. At the same time, as their deficiency is emphasized the limited and difficult weldability. In other words, some of those steels are weldable only with application of special measures related to controlled heat input. In that way, the favorable mechanical properties can be kept within the heat affected zone, with condition that the optimal welding technology is selected. Existing, very scarce and often unclear and insufficient recommendations for selection of the optimal welding technology are one of the causes of large number of flaws in welded joints. Mentioned problems, as well as others, can be successfully solved by proper selection of the procedure, filler metal and technology of welding, verified by experiments conducted in laboratory or in real operating conditions. Those experiments can not be performed in arbitrary conditions.

The test weldings were done with varying the energetic parameters within the recommended limits. Besides the visual control of the test joints, additional investigations were done by destruction of those realized welds. In that way we came up with the optimal welding regime. The geometry of welds was evaluated on performed test joints, because it is, besides the welding depth, hardness and microstructure of the welds individual zones, the basic criterion for the process control to grant approval to this manufacturing operation.

Several tents of test weldings were performed with the selected combination of the filler materials and adopted welding parameters, both on characteristic corner and butt joints. The macrographic and micrographic investigations were then performed on those samples.

After the detailed analysis of the most important properties of the base metal and estimates of its weldability, selection of the optimal combination of the filler materials, methods and technologies of welding, as well as conducted voluminous model and other standard tests, we established the optimal technology of welding, which was then applied at very responsible welded structure. This structure was realized with the proposed technology and when subjected to rigorous tests it proved itself as very reliable.

Due to all that was said, we must emphasize that, in order to achieve adequate properties of the welded joints, close to properties of the base metal, one must obey recommendations prescribed by the steel manufacturers, as well as knowledge reported by other researchers in the field. Since the literature in this area does not contain an abundance of papers, we consider that our work is an attempt to establish the necessary procedure for welding of the very responsible structures. For the more complete estimate of the welded joints' reliability, additional investigations need to be conducted, especially from the aspect of the welded structures integrity, based on methods and criteria of fracture mechanics.

Thus, partially due to results reported in this paper, technologists will obtain the possibility to predict in advance, in a very short time period, the mechanical and metallurgical properties of joints of this class of high strength steels. This will be possible without conducting the large number of practical tests or relying on personal experience of a designer.