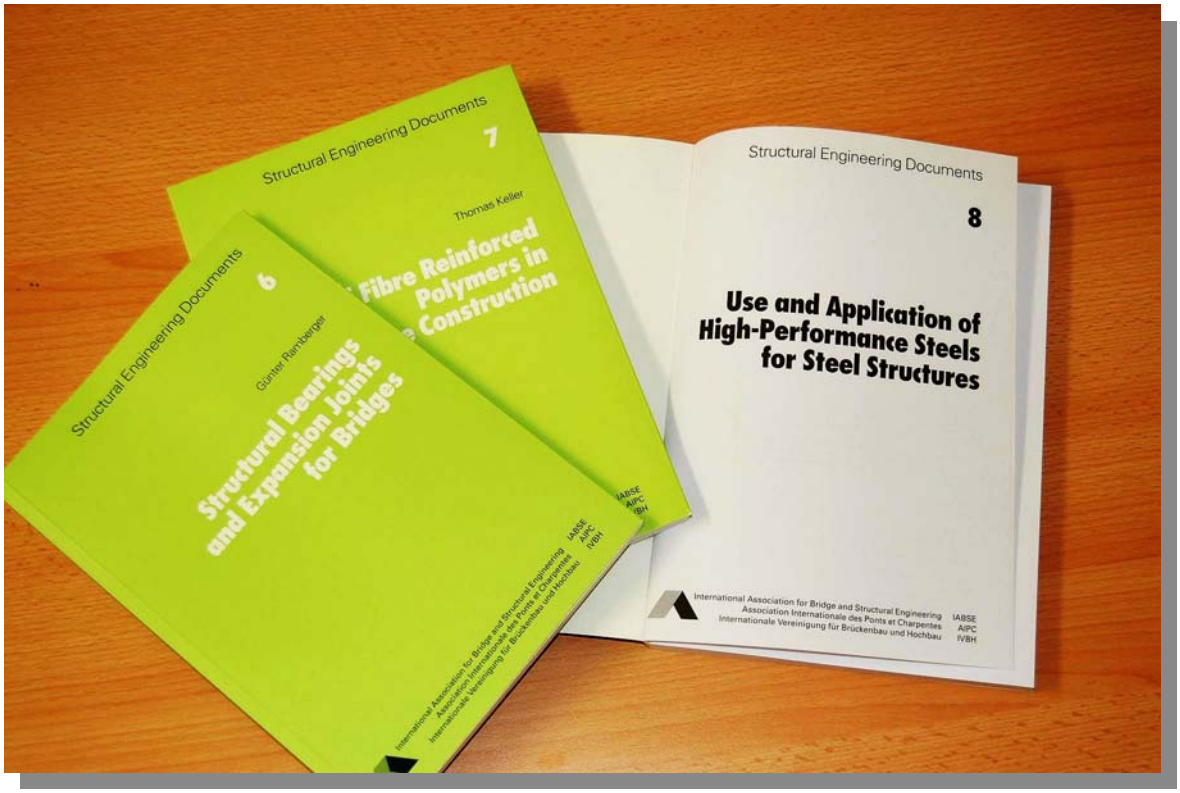

Structural Engineering Documents
Guidelines for Authors

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Guidelines for SED Authors

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- **Layout:** Different odd and even headers and footers. Headers and footers 1.5 cm from edge.
- **Margins:** Inside: 2.5 cm Outside: 1.75 cm Top: 2.5 cm Bottom: 1.75 cm Gutter: 0 cm
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- **Equations**

Use the equation editor of the selected word processing program. Equations are not indented. Number equations consecutively by chapter number and equation number, and place the number with the tab key at the end of the line, between parentheses. Refer to equations by these numbers. See for example Equation 2.1 below:

$$K_t = \left(1 - \frac{R^2 \cdot \tau}{c_a + \nu \cdot \tan\delta}\right)^4 \cdot k_1 \qquad (2.1)$$

- **Tables**

Locate tables close to the first reference to them in the text and number them consecutively by chapter number and equation number. Explanations should be given at the foot of the table, not within the table itself. Type the caption above the table in Times New Roman 12 point italic. See for example Table 1.1.

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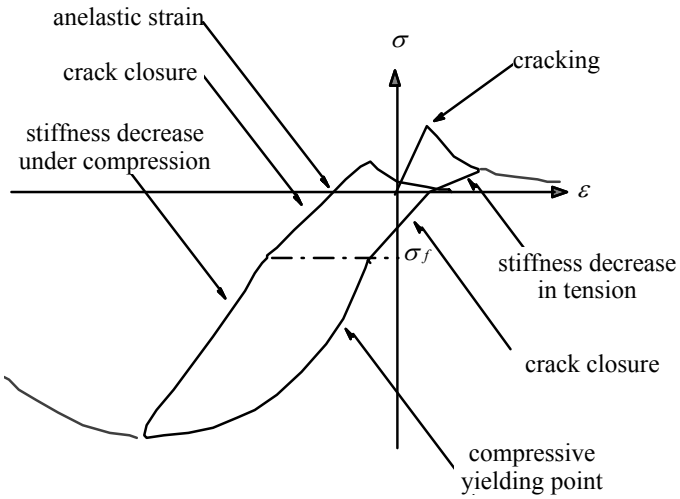

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Structural Engineering Documents

8

Hans-Peter Günther

Use and Application of High-Performance Steels for Steel Structures

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Foreword

Due to their good material and fabrication properties High-Performance Steels (HPS) are finding an ever increasing use in structural applications, especially in bridge design. However, the development and the code requirements of the various countries and regions in the world differ markedly from each other.

With this background, the members of Working Commission II of the International Association for Bridge and Structural Engineering (IABSE), especially Prof. Joël Raoul from SETRA, Paris, had the idea of preparing a state-of-the-art document on the use and application of this new generation of steel grades. This proposal, supported by the chairperson of Working Commission II, Prof. Dr. Ulrike Kuhlmann, was the starting point for the preparation of this document.

In comparison to existing Structural Engineering Documents which were written by only one or two experts, this document includes contributions from a number of experienced international authors showing the worldwide development of High-Performance Steels.

I wish to acknowledge the support given to the preparation this document and express my thanks to all contributing authors and especially to Prof. Dr. Bernt Johansson, Prof. Dr. Chitoshi Miki and Dr. Sylvie Boulanger for their support and involvement in organizing the contributions from the various countries. I also want to thank Prof. Joël Raoul who had the initial idea and Prof. Dr. Ulrike Kuhlmann who gave me the opportunity and time to coordinate the whole document. Many thanks are also given to Dr. Geoff Taplin who has spent much time in reviewing and rereading the whole document.

Finally I would like to thank IABSE for the publication of this Structural Engineering Document.

Stuttgart, May 2005

Dr. Hans-Peter Günther
University of Stuttgart

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1 Introduction and Aim

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Over 15,000 tonnes of "High-Performance Steel" (HPS) were used to build the Millau viaduct in France, in order to satisfy the performance criteria of the design team. Steel grades of that category generally lead to cost reductions, smaller sizes of components, lightweight structures and less welding work. Most importantly, these new grades contribute to a sustainable environment due to improved durability properties and reduced material use. For medium and long span bridges, weight reduction can reach 20%.

"High-Performance Steel" (HPS) is the designation given to steels that offer higher performance in tensile strength, toughness, weldability, cold formability and corrosion resistance compared to the traditionally used mild steel grades. In the past fifteen years, there have been significant improvements in steel making technologies, both in terms of metallurgical advances, and rolling and heat treatment process developments. One of the important technologies in this context is the Thermo-Mechanical Control Process (TMCP) that adequately controls rolling and cooling within the steel plate production in order to generate fine microstructures. The TMCP technology has been instrumental in providing higher strength, better weldability and excellent toughness qualities. Only through these technological breakthroughs has it been possible to produce HPS for the construction industry.

The development of HPS goes a long way to address a new societal demand for slender lightweight structures for the design of medium to long span bridges and multi-storey buildings. In such structures, there is a strong requirement to use high strength materials that can also meet erection and fabrication demands. HPS adequately fulfills these requirements leading to economical bridge and building structures with a great potential use for new effective and aesthetic structural solutions.

To encourage engineers to consider HPS in their designs, especially in the field of bridge construction, the deployment and sharing of specialized knowledge on this new steel grade was deemed essential. At the moment, current design codes do not contain sufficient guidelines to fully explore the properties of HPS. Hence, the scope of this document is to provide:

– information on the production process and its impact on steel quality,
– chemical composition and mechanical properties of HPS in terms of strength, toughness, weldability and corrosion resistance,

– Optimized HPS girders can be attained by using a hybrid combination of HPS 70W in the negative moment top and bottom flanges, and Grade 50W or HPS 50W in other regions.
– Optimized HPS girders have been shown to result in lower first cost and are expected to have lower life-cycle cost.

High-performance steels are justifiably claimed to be "The Bridge Construction Material for the New Century."

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