Editorial

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High-strength steels are increasingly being used in structural applications. Key properties such as toughness and weldability continue to improve as advances are made in production processes and metallurgy. Although they cost more than normal strength steels, in many design situations the cost penalty is easily outweighed by the strength increase, for example S460 steels are 30% stronger than S355 steels, yet the cost premium is only about 10%. Additional benefits of using smaller sections are less welding and painting are required, as well as lower transportation costs. An increase in net-to-gross area ratio for each floor of a building is also advantageous, especially for commercial buildings.

In general, high-strength steels are most suitable for heavily loaded members, often where the steel elements would otherwise be very thick. Typical applications include relatively stocky, gravity columns for buildings taller than about 4 to 7 storeys. Weight savings can also be made using high-strength steels for lateral stability systems, transfer beams and bracing members in high rise buildings.

Demand from construction specifiers has led to European product standards for hot rolled products (EN 10025 and EN 10149) now covering steels with strengths up to 960 MPa and the forthcoming revisions of the standards for hollow sections (EN 10210 and EN 10219) will do likewise. Running in parallel with these developments to product standards, the scope of the main part of the European steel design standard, Eurocode 3 (EN 1993-1-1) is being extended to cover steels with yield strengths up to 700 MPa. The possibility of developing a new part of Eurocode 3 giving supplementary rules for steels with strengths up to 960 MPa is currently under discussion.

This two-part themed issue aims to capture the state-of-the-art in design of high-strength steel structures. The first paper (Ma *et al.*, 2017) presents a review of recent tests on built up, hot-finished and cold-formed hollow sections made from steel with strengths of 690 MPa and higher. The applicability of European, American and Australian design rules to these members are discussed.

The second paper (Yang *et al.*, 2017) uses two different experimental techniques to investigate the distribution of residual stresses in welded circular hollow sections made from steel with yield strength of 690 MPa. Comparisons are made with normal strength steels. The sensitivity of the residual stresses to galvanising, and varying the diameter-to-thickness ratio, are also studied.

The third paper (Schillo and Feldman, 2017) presents an experimental and numerical study of the rotational capacity of high-strength steel I-shaped beams. While the specimens with yield strength 960 MPa showed very low rotational capacity, the results for the specimens with strength 700 MPa achieved their plastic moment resistance and exhibited good rotation capacity, demonstrating the potential for using plastic global analysis methods for steels stronger than 460 MPa.

The fourth paper (Jiang *et al.*, 2017) presents a numerical investigation of how the fabrication process affects the axial compression strength of high-strength steel welded box columns, including a simulation of the welding process in order to generate residual stress patterns. The effect of post-weld heat treatment on residual stresses are also studied.

The fifth and sixth papers study the use of high-strength steels to enhance the resistance of steel frames to seismic loading. The fifth paper (Chen *et al.*, 2017) is an analytical study of the benefit of using high-strength steels in the novel 'tension only concentrically braced steel beam-through frames' (TOCBTTFs) structural system in which the frame is designed to remain elastic while concentrating damage on the replaceable braces during an earthquake. The sixth paper (Ke *et al.*, 2017) describes the development of a seismic damage control evaluation method for a system comprising high-strength steel frames with energy dissipation bays (EDBs), calibrated against a large-scale laboratory test of a two storey, two bay frame with EDBs.

Finally, the seventh paper (Šmak *et al.*, 2017) presents an experimental study of the strength and hardness of welded joints between steels of strength 700 MPa and steels of strength 235 and 355 MPa, investigating the effect of different electrodes and weld parameters.

I hope that reading these papers informs and equips you for future designs using high-strength steel.

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- EN 10025 Hot rolled products of structural steels.
- EN 10149 Hot rolled flat products made of high yield strength steels for cold forming.
- EN 10210 Hot finished structural hollow sections of non-alloy and fine grain steels.
- EN 10219 Cold formed welded structural hollow sections of non-alloy and fine grain steels.
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