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Editorial

Editorial for special issue on Sustainable Metallic Structures

A large number of metallic structures in civil engineering (such as road and railway bridges, offshore structures, pipelines, wind turbines, communication towers and mining equipment), aerospace and mechanical engineering (such as aircrafts, ships, trams and trains) are aging. Most of these structures are subjected to cyclic loading. It is estimated that fatigue contributes in about 90% of all service failures in metallic components. The increasing service loads and harsh environmental conditions make these structures even more vulnerable.

Sustainability is defined, according to the Eurocode EN 1990 (Basis of Structural and Geotechnical Design), as the "ability to minimize the adverse impact of the construction works on non-renewable resources in the environment, on society, and on economy during their entire life cycle". Strengthening of existing structures can help to prolong the lifetime of the structures without major construction works (e.g., no need to demolish of the old structure and no need to build a new one). For example, for the case of old bridges, demolishing and reconstructing of old bridges requires quite a lot of material, planning, structural works, transportations and energy, which may have negative impacts on the environment and lead to an increased CO_2 emissions. In addition, many of the old bridges are often historic (with national and international importance) and demolishing them may have adverse cultural or economic impacts on the surrounding environment (e.g., landscape change and less tourist attraction). Therefore, strengthening of existing structures can increase their service lives and minimize the adverse impacts of the (re)construction works on the environment, society, and economy, which may ultimately result in an increased sustainability. This Special Issue will serve as a platform to present new strengthening techniques that can enhance the sustainability of existing metallic structures by increasing their lifetime through application of new advanced materials and innovative technologies.

Advanced materials, such as carbon fibre-reinforced polymer (CFRP), shape memory alloy (SMA), can be used to increase the sustainability of metallic structures. The CFRP materials are composites with high strength to weight ratio, non-corrosive and have a superior fatigue performance. This Special Issue includes several articles that explain the applications of prestressed, non-prestressed, bonded and unbonded CFRP composites for retrofitting of metallic (i.e., steel and aluminum) details. It has been shown that the CFRP composites can enhance the fatigue behavior, stiffness, ultimate-load, torsional and shear capacity of metallic members. Moreover, SMAs are a new class of structural metals, which are intelligent and have the capability to recover their shape after a permanent deformation at room temperature followed by a subsequent heating and cooling. It has been shown that SMAs can substantially increase the service life of metallic members. In this Special Issue, applications of two different SMAs, NiTi and iron-based SMAs, for structural strengthening of metallic members are discussed.

This Special Issue includes 20 high-quality articles that present new advanced techniques for strengthening of metallic structures. A total number of 42 articles were initially submitted to the Special Issue. Each article has been peer-reviewed by at least four international experts in the field. A total number of 20 articles were then selected for publication in this Special Issue. In summary, the articles can be categorized in three different groups. The first group focuses on applications of CFRP composites for flexural, fatigue, shear and torsional strengthening of metallic members (e.g., plates, beams and hollow sections). The second group aims to develop and characterize a CFRP/SMA hybrid patching system for fatigue strengthening of cracked steel details. Finally, the third group of articles introduces the application of iron-based SMA for strengthening of steel members.

The articles in this Special Issue were handled by the Guest Editor, however, the articles, in which the Guest Editor has been listed as a co-author, were handled independently by a respective regional editor of the journal. The guest editor would like to thank all the authors and reviewers for their contributions in this Special Issue as well as the editorial office of the Engineering Structures, and, in particular, Prof. Herbert Mang, for the efforts and supports in establishing the Special Issue.

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