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Steel Construction publishes peer reviewed papers covering the entire field of steel construction research. In the interests of “construction without depletion”, it skilfully combines steel with other forms of construction employing concrete, glass, cables and membranes to form integrated steelwork systems. Since 2010 Steel Construction is the official journal for ECCS- European Convention for Constructional Steelwork members. You will find more information about membership on the ECCS homepage.

## Topics

Robert Kroyer, Andreas Taras

### Ultimate and fatigue limit states of existing steel railway bridges

For several years now, the recalculation and assessment of the load-bearing capacity and fatigue strength of existing railway bridges has been playing an increasingly important role in the infrastructure management of railway operators. Currently, many bridge structures have been in operation longer than was foreseen during their planning and construction. In addition, the axle loads on many lines, as well as the demands on the reliability of the verification results, have steadily increased. The guideline DB RIL805, used for the verification of railway bridges in the Deutsche Bahn network, is currently being updated to take into account the increased requirements for structural safety and the desired increases of the useable life of existing bridges.

Pinger, Thomas; Müller, Thomas; Kaucke, Christoph; Straetmans, Boris; Wessel, Waldemar

### Hot-dip galvanizing of high strength hot-finished hollow sections

The galvanizability of high-strength, hot-finished hollow sections was investigated as part of a test program. Here, the galvanizing of square sections made of steel grades ranging from 355 - 620 MPa was carried out, using a classic, quasi-rare zinc melt on the one hand and a zinc-5% aluminium alloy on the other. To determine the influence of galvanizing on the material properties, samples were taken from the galvanized specimens, tensile tests and Charpy-V-tests were performed on them, and the results were compared with those in the ungalvanized initial state. Furthermore, the optical and microstructural characteristics of the zinc coatings were investigated, as well as possible cracking due to liquid metal embrittlement (LME). The results show that the two galvanizing processes used in the test program show no negative effect, but rather tend to have a positive effect on the mechanical properties of the steels tested. In all cases, stable zinc coatings are formed that exhibit the expected characteristics. Cracking as a result of LME could not be detected.

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## Topics

Haohui Xin, Jie Li, Milan Veljkovic, Yuqing Liu, Qing Sun

### **Strength Evaluation of Grade 10.9 Bolts Exposed to Multiaxial Loading Based on Micromechanically Failure Index: MCEPS**

The bolted joints are generally exposed to combined actions in the steel structures applications. The research on ultimate capacity exposed to combined tension and shear actions, twin shear actions, and combined tension-twin shear actions is relatively limited. In this paper, the fracture locus of grade 10.9 bolts is calibrated based on the mesoscale critical equivalent plastic strain (MCEPS). The ultimate resistance of bolts exposed to multiaxial loading is numerically evaluated based on the ductile fracture simulation. The ultimate bolt resistance exposed to multiaxial loading is compared with current design standard. The results showed that predictions for the grade 10.9 bolt exposed to multiaxial loading from Chinese code GB 50017 and American code AISC-360 were not on the safe side while the European code EN1993-1-8:2005 provides a bit on a conservative side for the bolt exposed to multiaxial loading. Two modification factors, namely multiaxial loading factor for shear resistance  $\lambda_{xi\_v}$  and multiaxial loading factor for tensile resistance  $\lambda_{xi\_t}$ , were proposed for better prediction of bolt strength exposed to multiaxial loading.

Sander Suur, Ferdy Hengeveld

### **Borssele V Slip Joint connection: Design, Certification and Installation of the world's first full size submerged Slip Joint**

In April 2020, the world's first full size submerged Slip Joint connection was installed in the offshore wind farm Borssele Site V. With this event, a new alternative TP/MP connection was launched in the offshore wind market. An extensive qualification program in terms of numerical modelling and testing was launched prior to the Slip Joint installation. This process was witnessed, reviewed and accepted by DNVGL. This led to a certified Slip Joint design for Borssele V, with a 9.5 [MW] WTG on top of the foundation, as well as an A-level component certificate for the Slip Joint in general. The installation of the Slip Joint for Borssele V is the first time this connection is used in a commercial full size wind turbine. The implementation of the Slip Joint connection in Borssele V showed the benefit of the Slip Joint in terms of a simple, safe and fast installation. As well as the option to use the Slip Joint submerged, allowing for a more optimized weight/length split between MP and TP and making use of smaller installation vessels. After, and during, installation a monitoring campaign was launched to provides lessons into future Slip Joint designs.

Meera Moha

### **Damage Criterion Approach to High Strength Steel RHS Truss Joints**

This paper describes finite element simulations of the structural deformation and material fracture behaviour of high strength steel RHS K gap truss joints. The fundamental scope was to examine whether the joint strength predictions based on the behaviour of lower strength and higher ductile steel with a yield stress of 355 MPa or less would hold good for higher strength 450 MPa yield steel with lower ductility. The reliability analysis of FEA indicates that for failure modes associated with local buckling, yielding and deformation (chord side wall failure, chord face plastification and brace failures due to reduced effective width), the existing approach could be extended for higher strength tubes with modifications, but for failure modes associated with fracture or ductility or liable to brittle failure modes (tearing in the tension brace and chord punching shear) a strength reduction modifying factor was required.

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## Topics

The finite element simulations incorporated a damage mechanics approach to calibrate experimental results in both fracture and deformation modes of failure. The paper proposes a new formulation for strength, incorporates reduced ductility in high grade steel with a modifier function that is not based on yield stress but instead recognises the reduced ultimate strains, damage parameter for fracture and the ultimate stress of the material.

Alkarawi, Hassan (proxy) (contact); Shams Hakimi, Poja; Al-Emrani, Mohammad

### **High-cycle variable amplitude fatigue experiments and a design framework for bridge welds treated by high-frequency mechanical impact**

Fatigue enhancement with high-frequency mechanical impact (HFMI) can enable effective design and construction of steel bridges. However, bridges may experience high and varying mean stresses, the effects of which are not covered today by any design recommendation or in the literature for HFMI-treated joints. In this work, fatigue experiments with realistic in-service bridge loading were conducted, showing the same high fatigue performance as for constant amplitude loading. The effect of mean stress in spectrum loading was quantified and a method to account for it in an equivalent manner was proposed. A design framework was developed for design and engineering purposes.

## AD FORMATS AND PRICES

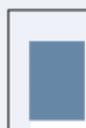
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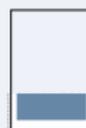
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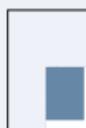
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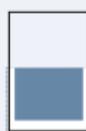
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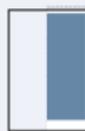
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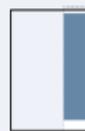
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portrait (WxH)  
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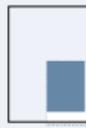
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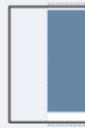
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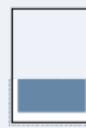
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