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Editorial

This issue of *Bridge Structures* contains six papers that were presented at the 1st International Conference on Fatigue and Fracture in the Infrastructure which was held in Philadelphia, Pennsylvania, USA, on August 6 – 9, 2006. The issue leads off with a paper by Wright *et al.* on ''Limit load analysis for fracture prediction in high-performance steel bridge members''. The AASHTO fracture toughness requirements for bridge steels provide a minimum level Charpy-Vee Notch (CVN) toughness that is based on linear-elastic fracture mechanics theory. Therefore, most bridge steels exhibit behavior in the lower CVN transition region. Numerous case studies and laboratory test results show that traditional bridge steels fracture in a relatively brittle mode (inter-granular cleavage), even though the toughness is sufficient to exceed the theoretical validity limit for linear elastic fracture mechanics based on K_{Ic} behavior. Linear-elastic fracture mechanics still gives generally good results for these steels, since the behavior mode is still primarily brittle. The recent introduction of grades of high-performance steels (HPS) are providing much higher levels of CVN toughness compared to traditional bridge steels. As an alternative to predicting fracture and generating resistance curves (*R*-curves) for bridge I-girder geometry, the authors propose a plastic limit load analysis to provide fracture prediction for high-toughness steels in bridge structures. The paper demonstrates that limit load theory is a viable alternative for the I-girder geometry.

Fatigue design of railroad bridges in North America is based on the expected number of cycles for a typical unit-coal train. While the assumed train and its frequency of application of loading are adequate for design of new spans, it does not represent all loadings. This can result in error when rating for and estimating fatigue life. In his paper, ''Estimation of cycles for railroad girder fatigue life assessment'', Dick presents the fundamental formulation for the moment range and variation in live-load moment for railroad loadings. The paper displays the train types representing different eras of weights and car types as these have changed over time. On the theme of railroad bridge fatigue life assessment, the key factors to be evaluated include the geometric structural fatigue detail category and its stress range to cycle capacity ($S-N$ curve), and the applicable stress ranges. In ''What's important in railroad bridge fatigue life evaluation'', Sweeney examines these factors in the evaluation of the remaining safe fatigue life of a railroad bridge. The author draws attention to the dependence of the applicable stress ranges on the load spectra and the geometric properties of the structure being evaluated. The paper presents a number of short examples to demonstrate the influence of the key factors on railroad bridge fatigue life.

In ''Use of weld toe stress singularities in evaluating stress intensity factors for welded details'', Metrovich and Fisher present a closed form solution for the singular stress field for evaluating the stress intensity factor, *K*, of a crack emanating from the weld toe. The authors demonstrate that the proposed closed form solution for the stress intensity factor is nearly identical to numerical results for two distinct crack paths. The closed form solution provides new insight into the behavior of the stress intensity factor for very short crack lengths, where much of the welded detail fatigue life is spent. The results have direct relevance to welded bridge details when assessing a cracked condition. Recently fatigue performance of treated welded joints was evaluated in large-scale rolled and built-up ferrite-steel beam specimens having yield strength of 345 – 690 MPa. The welded details were comprised of transverse welds at the cover-plate terminus and at the transverse stiffener to tension flange joint. The welds were treated at the toe by Ultrasonic Impact Treatment (UIT). In as-welded condition, these details are characterized as Categories C′ and E′ in the AASHTO Specification. Accelerated constant amplitude fatigue tests were conducted at various treatments of tensile minimum stress and stress range, resulting in positive stress ratios up to 0.6. The test results confirmed that the post-weld impact treatments substantially improved the fatigue performance of welded details.

In ''Modified AASHTO design S – N curves for post-weld treated welded details'', Roy and Fisher propose simplified fatigue design guidelines for post-weld treated details conforming to AASHTO Category C' and E' details.

Finally, Wang *et al.* propose a fracture model based on the Monte-Carlo method in ''Application of probabilistic fracture mechanics in evaluation of existing

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riveted bridges''. The model is based on fatigue damage accumulation theory and probabilistic fracture mechanics analysis. The authors present, as a case study, their model prediction for the fatigue safety evaluation of the Zhejiang Street Bridge in Shanghai, China. According to the evaluation results, the safe inspection intervals and maintenance strategy are established.

Each of these papers is of considerable impact and presents a significant contribution to the *state-of-the-art* in the field of fatigue and fracture of bridges structures.

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