

## Editorial

Over the last few years, remarkable technological advances have been achieved in bridge engineering technology. These cover a wide spectrum of issues, ranging from design, maintenance, and rehabilitation methodologies to material and monitoring innovations. Within an international framework of exchanging the state-of-the-art in the field of bridge engineering, the Fourth New York City Bridge Conference was held on August 27–28, 2007. This issue of *Bridge Structures* contains a select number of papers that were presented at the conference. These papers are valuable contributions to the body of knowledge in bridge engineering technology.

Twin I-girder structural systems are often encountered in practice on pedestrian bridges, railroad bridges, and temporary conditions during multi-girder bridge erection and demolition. This issue leads off with a paper by Kozy and Tunstall on the “Stability analysis and bracing for system buckling in twin I-girder bridges”. The current paper is based on an in-depth stability analysis and bracing design conducted on a twin I-girder pedestrian bridge recently constructed in the state of Minnesota, USA. The authors demonstrate that the strength of non-composite twin-girder systems without lateral bracing can be controlled by the limit state of “system” or “global” buckling; however, the existing literature and governing design specifications do not adequately address this limit state. For twin-girder systems with partially-braced spans and/or non-prismatic cross-sectional properties, a complete 3-D FE buckling analysis should be considered for quantifying buckling strength and associated bracing forces; either linearized eigenvalue analysis or complete non-linear incremental collapse analysis. These FE stability analysis models can be verified effectively by checking the vertical, lateral, and torsional stiffness against results provided by classical solution techniques.

An incrementally launching technique is widely used for the construction of continuous concrete bridges. During construction, the static scheme of these bridges varies continuously, with the advance of the deck above piers producing temporary stresses that are different from those occurring in service. An approach to analyse construction phases of curved incrementally launched bridges is presented for concrete single box girder, using the Transfer Matrix Method. Arici and Granata present a procedure for the “Analysis of curved incrementally launched box concrete bridges using Transfer Matrix Method”. This

procedure allows engineers to carry out parametric studies for the optimization of structural design of curved concrete launched bridges.

A substantial number of orthotropic decks suffer from fatigue related problems, to be attributed to increase in traffic loads, bad detailing, or lack of understanding of the mechanisms leading to these problems. Of the various fatigue prone locations, the rib to floorbeam joint is the most challenging, since it is subjected to a complex set of in and out of plane stresses. In “Examination of local stresses in relation to fatigue failure at the rib to floorbeam joint of orthotropic plated bridge decks”, De Corte *et al.* present the case of continuous longitudinal ribs passing through the floorbeam web by an additional cope hole. In such a configuration, the first fatigue crack initiating at the joint can either grow in the floorbeam web or in the rib walls, depending on the geometric conditions. Both situations are addressed in the paper, providing a parametric study of distortion induced rib stresses as well as a simplified method for cutout stress calculations.

Over the past century, the AASHTO-specified live loads have been evolving to catch up with the ever-changing knowledge and trends of vehicular traffic. The latest loads are based on past Canadian traffic data, and may not represent modern or future traffic conditions in some US jurisdictions. Today, weigh-in-motion (WIM) systems can provide a solution to this dilemma by providing valuable site-specific traffic data for bridge design and evaluation, weight-limit enforcement, and the likelihood of illegally overloaded trucks causing premature bridge deterioration. Bridge owners have long recognized the importance of incorporating site- or state-specific truck loads in their bridge evaluation and preservation programs. The AASHTO LRFD and LRFR Bridge Specifications have evolved to advance the trend toward information-sensitive specification formulation. When warranted, the specified live loads can be enhanced utilizing more relevant site or route data. In “Enhancement of bridge live loads using weigh-in-motion data”, Sivakumar and Sheikh Ibrahim review the evolution of US bridge design live loads, and discuss the possible enhancement of bridge live loads and load factors using WIM data. The paper presents recent investigations for evaluating the design live loads for the State of New York, and calibrating the live load factors used in rating for the State of Oregon using WIM data.

The New York investigation indicates that truck loads at two studied sites may be significantly heavier than the AASHTO specified loads. It also indicates that WIM enhanced site-specific fatigue design loading is significantly heavier than the AASHTO LRFD fatigue design truck. In the Oregon investigation, State-specific WIM data resulted in a significant reduction in the live load factor for legal and permit trucks for the entire State of Oregon, which is attributable to the State's regulatory and enforcement environment.

Curved steel box-girder bridges are aesthetically pleasing and functionally effective, particularly at highway interchanges with curved alignments. A parametric analytical study of the seismic behavior of this type of bridges has been performed. Wu and Najjar present a three-dimensional finite element model to perform a "Parametric seismic analysis of curved steel box-girder bridges with two continuous spans". Multiple parameters of the model are evaluated, including girder curvature, bearing condition, diaphragm spacing and free vibration characteristics. Results of the study with potential design recommendations are outlined in this article presentation. Seismic criteria by local and national specifications are contrasted and discussed in light of the analysis results.

On the theme of seismic performance, four unbonded post-tensioned precast segmental concrete columns were subjected to pseudostatic simulated lateral seismic loading in the Charles Lee Powell Structural Research Laboratories at the University of California at San Diego, USA. The influence of parameters including steel jacket confinement, prestress level, and column aspect ratio on column force-deformation characteristics, energy dissipation, damage level, and failure mode was studied. Hewes presents these "Seismic tests on precast segmental concrete columns with unbonded tendons". Key test results are compared to those predicted by a simple analytical model and good agreement is observed. It is concluded that this structural system can be designed to resist severe seismic demands while offering the benefit of reduced post-earthquake damage and the associated economic loss.

Pedestrian-induced vibrations (PIV) on footbridges, overpasses, and floors are attracting more attention from designers and are becoming an important dynamic excitation to consider as well as wind and seismic loads. A key reason for this trend is the public awareness and higher performance standards set on new projects where better comfort is sought and lively structures are less tolerated. At the same time, more efficient material utilization and new construction methods are producing more efficient structures with less capability to dissipate the energy input (low damping) and, as a result, are more sensitive to dynamic excitations. In addition, recent research has led to an improved understanding of the pedestrian vibration

problem and, with the advances in both practical and refined analytical methods, designers may better determine which vibration control measures are appropriate for an optimized design. In "Pedestrian-induced vibrations on footbridges: advanced response analysis", Stoyanoff *et al.* present the basics of the PIV problem and a new method for direct time domain simulations of pedestrian-induced vibrations that allows a rather realistic evaluation of a bridge's dynamic performance and evaluation of comfort to its users. Based on statistical distributions of key parameters such as gait frequency, phase and length, personal weight and type of activity, a wide variety of loading scenarios may be readily evaluated. Most importantly, the hypothesis of "lock-in" can be verified, which allows less conservative response estimates derived from methods based on formulae that assume post lock-in conditions. Finally, the authors include a brief discussion on vibration control.

Broken wires retrieved from suspension bridge cables display a wide range of critical crack sizes and corresponding ultimate strength. During tensile tests, most specimens fracture at short crack depths at a strength lower than the yield strength. In "Mechanics of environment-assisted cracking in bridge cable wire", Mahmoud and Fisher present the analysis of environment-assisted short crack growth in bridge wire. The authors demonstrate that the degrading environment in the bridge cable causes the reduction in the effective fracture toughness of the wire at the short crack location leading to brittle fracture. The paper presents a case study of short cracks observed during laboratory testing of bridge wire samples which failed at tensile stress below the maximum yield strength. The paper confirms the validity of linear elastic fracture mechanics in the analysis of environment-assisted short crack growth in the bridge wire at fracture. The authors introduce a bridge wire parameter, the effective fracture toughness,  $(K_C)_M$ , which could be significantly reduced at a short crack location due to environmental degradation. The paper presents a methodology to forecast the degraded strength of cracked wire, utilizing the fracture toughness criterion. The authors finally show that crack branching has no role in the mechanism of crack growth in the high strength steel bridge wire.

Each of these papers presents an original contribution to state-of-the art bridge engineering technology. The editor expresses a note of gratitude to the authors and reviewers of papers and acknowledges with appreciation their contribution.

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