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EDITORIAL

The first paper in this issue of *Bridge Structures*, by Shum *et al*., proposes a 'Complete function collocation method for solving preliminary cable-stayed bridge pretension forces'. The method calculates stay cable forces by solving a set of partial differential equations. The study reports that this mesh free collocation method can be used to solve practical structural engineering problems and provides an alternative to traditional finite element methods. A simple two-dimensional cable-stayed bridge is presented and is solved to illustrate this numerical method. Governing equations of deformation for a bridge structure are formulated in either Eulerian or Lagrangian coordinate systems. Point loads due to stay cables on bridge pylons and bridge deck are modeled by Fourier or Gaussian representations. Transverse natural frequencies of stay cables subject to no body forces and caused by flow induced vibration due to blowing wind are proposed. The preliminary computational procedure presented in the paper provides the basis for further analysis toward more realistic cable-stayed bridges, which would include nonlinear effects, live loadings and construction stage loadings. In recent years, nondestructive evaluation (NDE) techniques have become a critical component in both the condition assessment, and design verification of bridge structures.

In 'GPR imaging for bridge deck condition assessment', Abudayyeh *et al*. demonstrate the use of ground penetrating radar (GPR) to assess the integrity of bridge decks. GPR technique utilizes high frequency electromagnetic waves at the microwave or radio frequency range to investigate the subsurface condition. This technique is used to measure features such as cracks and voids. The authors present an evaluation of the effectiveness of the GPR in bridge deck assessment. Analysis and results of GPR scans from two bridge decks are presented and discussed. In addition, the GPR results are compared with those produced by the commonly used chain drag method for bridge deck evaluation.

On the topic of nondestructive techniques, Santini-Bell *et al*. present the results of 'Nondestructive testing for design verification of Boston's Central Artery underpinning frames and connections'. In March 2004 prior to the demolition of the Boston Central Artery viaduct, a research team implemented a program of nondestructive testing for design verification of two structural steel highway bents in Boston, Massachusetts. The tested support bents were part of the underpinning system for the original Interstate-93 Central Artery viaduct during construction of the new cut-and-cover tunnel below it. Upon opening of the tunnels, traffic was rerouted from the elevated viaduct, and the demolition process of the viaduct structure began. Two of the remaining support bents of the underpinning structure were fitted with sensors (strain gages, tiltmeters, slide wire potentiometers, and a 50-kip (222.4 kN) load cell) and loaded by a 50-ton (444.8 kN) crane. The measured structural response was compared to the expected response from finite element structural models, and the structural models were updated using parameter estimation techniques for design verification. Using as-built information, considering original design assumptions, and parameter estimation simulation results, the researchers selected a set of sensor types and locations for the nondestructive field test. Key design parameters of the underpinning finite element model, such as connection stiffness values, were successfully estimated using structural parameter estimation. As a result, the updated structural response correlated well with the collected nondestructive test data. Culvert structures are subjected to various combinations of earth loading from the soil cover, lateral earth pressure, and AASHTO wheel loading applied at center or edge along midspan of the top slab. As the soil cover increases from 0 to 3 m (10 ft), wheel loads are projected to the top slab using ASTM C890 procedure.

In 'Parametric study of load distribution in four-sided concrete box culverts', Awwad *et al*. present the results of a parametric study of load distribution in 108 four-sided precast concrete box culverts using three-dimensional finite element analysis and two-dimensional plane frame analysis. Three concrete box culvert sizes were chosen with various span lengths, constant rise, and standard laying width. Maximum bending moments and deflections were computed and evaluated. The study reports that the effect of wheel loading along midspan is significant and that the edge loading

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condition for a single box is more critical than center loading for soil cover less than 0.9 m (3 ft). The earth loading tends to gradually dominate as the soil cover increases, which is expected based on geotechnical engineering practices. The effect of wheel loading position along midspan (edge vs. center) for soil cover greater than 2.1 m (7 ft) is negligible. It is shown that the plane frame analysis and 3D FEA gave similar results for long-span culverts. However, for short-span (3.6 m or 12 ft) concrete box culverts, the plane frame analysis was less conservative than the 3D FEA by about 15% and 25% for moments and deflections, respectively; versus about 5% and 10% for long-span culvert (24 ft) considered.

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