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Editorial

Deterioration of bridge decks in the United States is an important issue due to its major impact on bridge maintenance costs nationwide. In “Reliability of bridge decks in the United States,” Tabatabai et al. present results of survival (reliability) analyses performed on bridge data for all fifty states and Puerto Rico. Data was obtained from the 2011 National Bridge Inventory (NBI) database. The end of service life is defined as a recorded NBI bridge deck rating of 5. The authors consider only non-reconstructed bridges and conventional bridge types and decks. The NBI-derived parameters included in the analyses were age, average daily traffic (ADT), deck surface area, and deck rating. Each state’s data were analyzed separately to assess and compare relative performance among the states. Deck reliability at an age of fifty years ranges from less than 20% to over 90%. The paper concludes that geographic regions with the highest overall 50-year reliability are generally in the northeastern and northern United States. Concrete bridge decks are typically reinforced with steel. However, corrosion has motivated the use of glass fiber reinforced polymer (GFRP) reinforcement as an alternative reinforcement material. GFRP is a noncorrosive composite material made of glass reinforcing fibers and a vinyl ester resin matrix. In axial tension, GFRP is elastic with brittle rupture at ultimate. Relative to Grade 60 steel reinforcement, GFRP tensile strength is about 150%, the elastic modulus is about 20%, and the unit weight is about 25%. In “Fatigue Behavior of GFRP and Steel Reinforced Bridge Decks Designed using Traditional and Empirical Methodologies,” Yost et al. investigate experimental behavior of two full-scale bridge decks, reinforced with steel and GFRP, and subjected to fatigue loading. Reinforcement is provided as required by traditional (TR) and empirical (EM) design methodologies on each transverse half of each deck. The decks are subjected to load cases corresponding to an HS25 truck axle positioned for critical positive and negative bending. Measured response before, during and after the two million cycles of fatigue loading per load case is used to evaluate compliance with serviceability limits on crack-width, deflection and material stress. The authors conclude for the GFRP reinforced deck, that both TR and EM are compliant with allowable limits, and that the EM load-sensor slope response is measurably less than the TR for like load cases. The paper reports similar results for the steel reinforced deck. The study validates the EM design methodology for use with GFRP reinforced concrete bridge decks. In March 2013, ninety-six high-strength steel rods installed on the lower housing of Shear Key S1 and Shear Key S2 at Pier E2 of the San Francisco-Oakland Bay Bridge, in California, USA, were loaded to their design load of 70% of their specified minimum ultimate tensile strength or Force ultimate, F_u. Within fourteen days, 32 of the 96 ASTM A354 Grade BD rods fractured. A metallurgical investigative team was tasked with examining the cause of the failures of the high-strength steel rods. In “ASTM F1624 Rising Step Load (RSL™) Testing for Hydrogen Embrittlement Threshold of Threaded cut outs of A354BD Rods,” Crumly et al. present the metallurgical investigation of the fractures. The team attributed the rod failures to hydrogen embrittlement, which is a time-delayed fracture mechanism by which the steel becomes brittle following exposure to hydrogen and results in an in-service fracture of the rods. Box steel girder bridges have gained popularity due to their aesthetics, serviceability, and constructability, especially for projects with long spans and curved alignments. It is important to understand the response of steel box girder cross-sections to fire events. Braxtan et al. provide “Preliminary investigation of composite steel box girder bridges in fire.” The authors investigate a three span prototype bridge, which is modeled using Abaqus finite element modeling software. Sequential, uncoupled thermal and structural analyses are used to determine the response of the bridge during a hydrocarbon fire. The FEM models were verified using existing test data on steel and concrete composite beams, in addition to extensive convergence studies, to determine the validity of the modeling procedure.

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