Bridge Structures 16 (2020) 59–60
DOI:10.3233/BRS-200177
IOS Press

Editorial

Super lightweight deck can enhance load rating and functionality of bridges, particularly those identified as structurally deficient. In "Accelerated testing of super lightweight UHPC waffle deck under heavy vehicle simulator", Ghasemi et al aim to develop and experimentally validate a novel bridge deck. The proposed system comprises of an ultra-lightweight low-profile waffle slab of ultra-high-performance concrete (UHPC) with either carbon fiber reinforced polymer (CFRP) or high strength steel (HSS) reinforcement. Performance and failure modes of the proposed deck were initially assessed through lab experiments and finite element analysis to demonstrate that the proposed deck panel meets the AASHTO LRFD requirements. The proposed deck system is not susceptible to punching shear of its thin slab and fails in a rather ductile manner. To evaluate its long-term performance, the system was further tested under the dynamic impact of wheel load at the Accelerated Pavement Testing (APT) facility of the Florida Department of Transportation using a Heavy Vehicle Simulator (HVS). Mechanical properties of soil depend on many parameters. Moisture content is one of the key factors that impacts the soil's mechanical properties. Soil-pile interaction and pile displacement in bridges can, therefore, be impacted by the moisture content. In particular, pile displacement in Integral Abutment Bridges (IABs) due to daily and seasonal temperature variations is a problem that has been under investigation. IABs don't have joints and as a result all the load and deformation in the slab is transferred to piles. If piles are deformed beyond their yield point, plastic deformation can occur. Razmi evaluates the "Effect of moisture on mechanical characteristic of soil and interaction of soil-pile in integral abutment bridges", through computational modeling. An ANSYS Finite Element Model (FEM) is used to repeatedly change the moisture content of the soil and adjust the properties and compute the displacement in the piles. The study suggests that increasing the moisture content decreases several key parameters such as bulk density, young's modulus, cohesion and Poisson's ratio. The simulation results indicate higher displacements of the piles as the moisture content increases. This behavior can be explained by decreased elastic modulus. As a result, soil behaves more flexible and allows more displacement of the pile. The conventional design philosophy of bridges allows damage in the pier through yielding. A fuse-like action is achieved if the bridge piers are designed to develop substantial inelastic deformations when subjected to earthquake excitations. Such a design can avoid collapse of the bridge but not damage. The damage is the plastic hinge formation formed at location of maximum moments and stresses that can lead to permanent lateral displacement which can impair traffic flow and cause time consuming repairs. Rocking can act as a form of isolation by means of foundation uplifting which act as a mechanical fuse, limiting the forces transferred to the base of the structure. In "Rocking isolation of bridge pier using shape memory alloy", Rele et al propose a controlled rocking bridge pier foundation, which uses elastomeric pads incorporated beneath the footing of the bridge piers and external restrainer in the form of shape memory alloy bar (SMA). The rocking mechanism is achieved by restricting the horizontal movement of footing by providing stoppers at all sides of footing. The pads are designed to remain elastic without allowing their shearing. The pier, the footing and the elastomeric pads are assumed to be supported on firm rigid concrete subbase resting on hard rock. By performing nonlinear dynamic time history analysis in the traffic direction of the bridge, the proposed pier with the novel resilient foundation is compared against a fixed-based pier and classical rocking pier (CC). The paper suggests that the proposed pier rocking on elastomeric pads and external restrainer (CP + SMA) has good re-centering capability during earthquakes with negligible residual drift and footing uplift. In this new rocking isolation technique, the forces in the piers are also reduced and thus leading to reduced construction cost with enhanced post-earthquake serviceability. The effects of combinations of different types of bridge irregularities have not been studied in detail in the past and current seismic design codes do not address this issue appropriately. In their paper, Sajed and Tehrani are "Investigating the effects of combinations of irregularities on seismic ductility demands and mean response for four-span RC bridges considering displacement direction". The authors evaluate 76 regular and irregular bridges with irregularities in both superstructure and substructure, to investigate the impact of combinations of irregularities on the seismic ductility demands. The irregularity parameters considered in the study include irregularities in span arrangement, different lengths of columns, different abutments support conditions and different stiffness of superstructure. The bridges were designed and checked according to AASHTO provisions. Inelastic time history analysis was conducted using OpenSees software and ductility demands in bridge columns for different bridge configurations were predicted. Predictions of ductility demands were based on the mean responses obtained using a number of ground motion records. The study investigates the effect of considering displacement directions in predicting the mean bridge response (i.e., using different methods for predicting the mean response) for irregular and regular bridges. The paper suggests that the combinations of irregularities can significantly increase the ductility demands in some cases compared to the case of regular bridges.

Khaled M. Mahmoud, PhD, PE
Editor-in-Chief
Bridge Technology Consulting
New York, New York, USA