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Design issues of prestressed concrete bridges with corrugated steel webs

Prestressed concrete bridges with corrugated steel webs have emerged as a promising bridge form due to their remarkable advantages such as efficient prestressing of concrete, high buckling strength of steel webs and lightness. The behavior of this type of bridges is quite different from that of conventional prestressed concrete bridges. The presentation will focus on the investigations of the full-range and long-term behavior of these bridges. A sandwich beam theory was developed to investigate both the static and dynamic behavior numerically. In the development of numerical models, special emphasis was placed on the modeling of corrugated steel webs, external prestressing tendons, diaphragms, and the interaction between web shear deformation and local flange bending. The numerical models were verified by tests. By using the numerical models proposed, the static service behavior, dynamic properties, and long-term behavior were studied. The sectional ductility, deformability, and strength were evaluated by nonlinear analysis taking into account the actual stress-strain curves and path-dependence of materials. The failure mechanisms were studied experimentally and numerically for more accurate evaluation of safety-related attributes such as ultimate load, ductility, and deformability. The formation of the plastic hinge and its size were also studied thoroughly in view of their importance in the prediction of full-range behavior. The long-term behavior was also studied numerically and experimentally. Some design recommendations are provided here.

Biography

Francis TK Au obtained his BSc degree with first class honors, MSc degree with distinction and PhD degree from The University of Hong Kong. He joined Maunsell Consultants Asia as an engineer upon graduation with his first degree, where he was involved in new town projects, highway projects as well as marine engineering projects. He returned to the University of Hong Kong in 1988 after having 7 years of practical experience in the industry. He is engaged in research in bridge engineering and concrete structures. He has been involved in various projects, including the structural health monitoring system of the Lantau Fixed Crossing, vibration tests of Ting Kau Bridge, road surface failure on bridges, development of bridge design software and shrinkage problems of large podium structures. He was the recipient of HKIE Transactions Prize 2002 (Civil), Best Teacher Award 2003-04, Faculty of Engineering, HKU, OVM Paper Award for Prestressing 2009 (Class 1) of China Civil Engineering Society and OVM Paper Award for Prestressing 2012 (Class 2) of China Civil Engineering Society.

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