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Foreword

Infrastructure composites

For decades, civil engineers have dealt with different types of composite materials, including wood (natural composites), plywood (laminated natural composites), and concrete (particulate composites). In recent years, several major national and international research programs were launched to investigate the feasibility of using polymer composites in both seismic and corrosion construction applications. This includes the use of fiber reinforced polymer (FRP) composites as internal and/or external reinforcement, as well as building entire structures, such as bridges and industrial frame structures, from FRP materials.

The papers selected for this issue cover a wide range of critical issues concerning the use of FRP in concrete applications. This includes mechanical characterization, overall performance, durability and long-term behavior, as well as design and analysis. For example, the behavior of full-scale concrete beams retrofitted for shear and flexural with composites is presented by Kachlakev and McCurry. Sherwood and Soudki examined the general behavior of unreinforced and partially reinforced concrete beams strengthened with composite laminates subjected to rebar corrosion. Ramana et al. present the results of experimental and analytical studies on the flexural behavior of reinforced concrete beams with varying degrees of external composites strengthening. Shahawy, Mirmiran and Beitelman present another repair and rehabilitation application of composites. They present experimental results and an analytical confinement model for concrete members wrapped by carbon/epoxy laminates and subjected to axial compression loads. Another potential application of FRP composites is rehabilitation and repair of reinforced concrete moment frame joints. Mosallam presents a pilot experimental study on the cyclic performance of full-scale reinforced concrete moment interior frame connections strengthened and repaired with quasi-isotropic laminates, while Parvin and Granata present results of a study on the effect of using FRP composite overlays on the behavior of exterior "knee" joints. Chung presents results of a study on cement reinforced with short carbon fibers.

In the area of theoretical and numerical modeling of reinforced concrete members strengthened with composites, several papers are presented. Ferreira, Marques and César de Sá present an analytical study on predicting the behavior of reinforced concrete members strengthened externally with composites. Modeling of composite/concrete interface of R/C beams strengthened with composite laminates is presented by Ascione and Feo. Simulation of shrinkage distress and creep relief in concrete repair is presented by Rahman, Baluch and Al-Gadhib.

In recent years, FRP composites have been evaluated for internal reinforcement of concrete members, in lieu of steel rebars which are sensitive to corrosive environments. Alsayed, Al-Salloum and Almusallam examined the performance of glass fiber reinforced polymeric (GFRP) rebars as a reinforcing material for concrete structures. Kachlakev presents results of experimental and analytical study on the structural performance of concrete members internally reinforced with both unidirectional and off-axis GFRP rebars, while the time-dependent deformations of concrete beams reinforced with carbon fiber reinforced polymeric (CFRP) rebars is presented by Arockiasamy et al.

In the area of all-composite structures, Qiao, Davalos and Brown present a systematic analysis and design approach for single-span FRP deck/stringer bridges. Hashem and Yuan present results of experimental and analytical investigations on short pultruded composite compression members. Finally, Aref and Parsons present the design and performance of a modular composite bridge.

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