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Development and Applications of FRP Reinforcements (DA-FRPR'21)

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Editor:
Radhouane Masmoudi

American Concrete Institute
Always advancing

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Preface

Fiber-reinforced polymer (FRP) reinforcements for concrete structures and civil engineering applications have become one of the innovative and fast-growing technologies to stop the rapid degradation of conventional steel-reinforced concrete infrastructure. FRP reinforcements for construction can be divided into three main types: 1. External sheets or plates to rehabilitate and repair existing concrete and masonry structures, and in some cases steel and wood structures; 2. Internal FRP bars or tendons for new and existing reinforced concrete structures, and 3. FRP stay-in-place forms to be filled with unreinforced or reinforced concrete. A considerable and valuable development and application's work has been accomplished during the last three decades, leading to the development of numerous design guidelines and codes around the world, making the FRP-reinforcement technology one of the fast-growing markets in the construction industry. During the ACI Concrete Convention, Fall 202[illegible], four full sessions were sponsored and organized by ACI Committee 440. Session S1 was focused on the bond and durability of internal FRP bars; Session S2 on codes, design examples, and applications of FRP internal reinforcements; Session S3 on external FRP reinforcements; and Session S4 on new systems and applications of FRP reinforcements, such as CFFT post-tensioned beams, GFRP-reinforced concrete sandwich panels, FRP-reinforced masonry walls, CFFT under impact lateral loading, near-surface mounted FRP-bars, and GFRP-reinforced-UHPC bridge deck joints.

I would like to address my sincere thanks to the reviewers for their valuable dedication to review the submitted papers. Thanks to the authors for their patience during the review process. A special thanks to ACI Committee 440 Chairs, William J. Gold and Maria Lopez, for their support and collaboration in organizing these four full sessions! Thanks to Barbara Coleman, ACI SP & Session Coordinator, for her collaboration in organizing the full sessions and during the editing of the SP publication.

This ACI Special Publication is dedicated to my love Dima and my three children Nour, Alae, and Layana!

Pr. Radhouane Masmoudi, P.Eng., PhD., FCSCE
Chair of ACI Subcommittee 440D, "Research Development and Applications
(of Fiber-Reinforced Polymer Reinforcements)
Department of Civil & Building Engineering, University of Sherbrooke, QC, Canada

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Bond Study of Corrosion-Free Reinforcement Embedded in Eco-Friendly Concrete

Ali F. Al-Khafaji, John J. Myers, and Hayder H. Alghazali

Synopsis: This paper presents an investigation of the bond performance of corrosion-free sand-coated glass fiber reinforced polymer bars (GFRP) implanted in two types of fly ash-based eco-friendly concrete. Steel reinforcement is prone to corrosion and is expensive to fix, therefore finding an effective alternative has become a must. One of these alternatives is GFRP bar. On the other hand, conventional concrete (CC) is not issueless, as it significantly affects the environment through its high-intensity CO_2 emissions. Thus, other alternatives have been looked into to mitigate the CO_2 problems. One of these alternatives is partially substituting Portland cement with another CO_2 emission-free material such as fly ash. In this study, two levels (50% and 70%) of high-volume fly ash concrete (HVFAC) were used to investigate their bond performance with GFRP bars. Cylindrical specimens were tested under the effect of pullout load. Furthermore, the bars were investigated chemically and microstructurally to see if the fly ash had some influence of the GFRP bar. For concrete, performance rank analysis was carried out to identify the best concrete mix in term of slump, unit weight, cost, and bond strength. In addition, to verify the experimental work, two-dimensional finite element models were built using translator elements to present the bond action between the concrete and its reinforcement. The results of investigation showed that the bond strength of GFRP bars were less than that of mild steel owing to GFRP bar deformation. In addition, CC resulted a higher bond strength than HVFAC. The bar analyses did not yield any obvious signs of microstructural deteriorations or chemical attack.

Keywords: Bond Assessment, Pullout, Fly Ash, GFRP bar, Finite Element, SEM, EDS, FiC, Performance Rank Analysis