Theme 3-7: Structures and Structural Materials - 2023

Title	Name of the PI	List the Names of the Co-Is	Department	Abstract	Starting Date	Ending Date	Funding	Amount of Funding
Conductive Concrete Exposed to Elevated Temperatures	Zaid Ahmed	Ismail Alghussein, Munir Mbarouk, Ahmed Gahallah	CVE	Concrete is the second most consumed material in the world, second to only water [1]. Therefore, a huge number of studies were made related to concrete, and various concrete types were invented. Electrically conductive concrete is one of the newest types of concrete produced. Since conductive concrete is relatively new, very few studies and research were done to study the different characteristics of this special concrete. Thus, this research focuses on the following: Evaluate the compressive strength of electrically conductive concrete exposed to elevated temperatures.	01/10/2022	06/12/2022	URG	4000
Performance and Durability of CFRP-to-Concrete Anchored Bond under Harsh Environments	Rami Hawileh	Jamal Abdalla	CVE	The aim of this project is to investigate the durability of the bond between carbon fiber-reinforced polymer (CFRP) laminates and concrete when anchored with CFRP spike anchors and exposed to harsh environmental conditions. Experimental investigation will be conducted on externally strengthened concrete prism specimens with different FRP anchor configurations and subjected to different UAE harsh environments. Flexural bond tests will be performed on the prisms after exposing the specimens to four different environments including lab-controlled environment, sun, saline, and accelerated conditioning protocols (ACP) up to a period of 18 months. The degradation in the bond performance and the mechanical properties of the CFRP laminates and CFRP anchors will be thoroughly assessed. The outcomes of this proposed study will include observations and conclusions regarding the long-term performance of FRP anchors and FRP-to-concrete anchored bond when subjected to severe climatic conditions. In addition, bond-slip models will be generated for the tested prisms. This study will also propose an approach for evaluating the durability of FRP anchors, which is not yet specified in the existing design guidelines. Environmental reduction factors (CE) will be also proposed to account for the reduction in the anchored FRP-to-concrete bond under harsh environmental conditions. Accordingly, the findings of this study will lead to a deeper understanding and thus wider application of FRP composite materials and FRP anchors in strengthening and retrofitting of reinforced concrete structural members in the UAE and GCC region, where the effect of harsh environment on the durability of these materials is of a major concern.	01/07/2023	31/05/2025	FRG	594550
Performance of Reinforced Concrete Beams Strengthened in Flexure with Carbon Fiber-reinforced Polymer (CFRP) Laminates Anchored with Spikes	Rami Hawileh	Jamal Abdalla	CVE	External strengthening of reinforced concrete (RC) elements with fiber-reinforced polymer (FRP) composite sheets has been documented as an effective method to enhance the performance of such members. Despite the considerable advantages of FRPs in enhancing the flexural capacity of RC beams, the strengthened system is impeded by premature debonding of FRP laminates, prior to full utilization of the laminate's tensile strength. This would reduce the beam's strength enhancement that would fail in an unwarranted brittle failure mode. Numerous research studies have proven that anchoring FRP laminates could delay the FRP debonding failure mode. Among the many anchorage systems used, FRP spike anchors have shown promising results in improving the overall performance of externally bonded FRP system. However, most of the available data on FRP spike anchors were obtained from testing small size anchors under direct pullout. The range of dimensions for which the models in the literature were derived is also limited and need to be expanded to increase the confidence level of such models. In addition, the lack of design guidelines in most current codes of practice hinders the use of FRP anchors in many structural applications. Therefore, the aim of this research is to investigate different combinations of FRP anchor dimensions and its effect on the flexural capacity of externally strengthened RC beams with high modulus carbon FRP (CFRP) laminates. A total of fourteen RC beams will be cast and tested, out of which eleven will be strengthened with CFRP laminates with different anchor configurations. The parameters that will be varied are anchor to sheet area ratio (ASR), embedment depth, anchor diameter, fan length, number of CFRP plies, and number of CFRP spike anchors. Experimental results in terms of failure modes, load-deflection response curves, load-carrying capacity, and strain in the CFRP laminates of the anchored specimens will be compared to an unstrengthened beam and two beams strengthened with one and two layers of CFRP laminate, respectively. The findings of this research will help to reduce the knowledge gap on larger size anchors and would lead to widespread applications of using such composite materials in the UAE and globe.	01/06/2022	31/05/2024	FRG	595000
Strengthening of Shear Deficient RC beams using Anchored CFRP sheets	Ram iHawileh	Jamal Abdalla	CVE	The purpose of this project is to study the effect of anchoring carbon fiber-reinforced polymer (CFRP) U-Wrap sheets with FRP splay anchors to externally strengthen reinforced concrete (RC beams) in shear. The FRP anchors are expected to prevent or delay CFRP debonding from the adjacent concrete surfaces, hence utilizing most of the tensile strength of CFRP laminates. In addition, anchoring of externally bonded (EB) CFRP sheets could be necessary in cases where the drop web of T-beams is shallow. Out of the many anchorage systems that are being studied and implemented, FRP splay anchors had proven its efficiency in flexural strengthening of RC slabs. However, there is still a gap in the literature on the effect of FRP splay anchors on the strength and ductility of RC beams externally strengthened in shear with CFRP sheets. In addition, there are no design guidelines for the anchors in the current strengthening design codes of practice. To cover such a research gap, a total of twelve shear deficient T-beams will be cast and externally strengthened in shear with U-wraps CFRP sheets and anchored with different configurations of FRP splay anchor systems. The parameters affecting the efficiency of the anchors that will be tested in this study are the embedment depth, anchor inclination angle, anchor diameter for bent anchors, and anchor depth and diameter for straight anchors. The test results will be compared to a control unstrengthened T-beam, T-beam with unanchored U-wraps, and two completely wrapped rectangular beams. In addition, analytical models will be developed to optimize the design of the anchors and recommendations on the maximum allowed effective strain in the anchored U-wraps will be proposed. A pilot study was conducted on two strengthened T-beam specimens, one anchored and the other was unanchored. The test results showed that the anchors delayed CFRP debonding, improved the shear strength, and significantly enhanced the ductility of the unanchored RC beam specimen. Thus, the use of splay anchors would lead to a wider use of such lightweight and novel CFRP U-wrap composite materials in shear strengthening of RC beams in the UAE and globe.	01/06/2019	31/05/2022	FRG	140000
Structural performance and durability of Mortar and Epoxy Bonded Steel Mesh as External Strengthening Materials under UAE Harsh Environment	Rami Hawileh	Jamal Abdalla	CVE	The aim of this project is to study the bond durability and performance of reinforced concrete (RC) members externally strengthened in flexure with galvanized steel ultra-high strength micro-cord (GSM) sheets and subjected to harsh environment. An extensive experimental study will be conducted to compare the bond performance of the GSM sheets when attached to concrete surfaces with epoxy adhesives (GSM-E) or mortar (GSM-M). The laboratory tests will include tensile coupon tests, flexural bond tests using prisms, single shear pullout tests, and tests on RC beams externally strengthened with both systems. The specimens will be exposed to different environment including lab-controlled environment, sun, and saline exposures up to a period of 18 months. The degradation in the mechanical properties, bond strength, and flexural strength of both systems will be examined and compared. Observations and conclusions will be drawn regarding the performance of the three strengthening systems under the different environmental exposures. In addition, a revise approach to the current ACI 440 environmental knockdown factors (CE) will be proposed for each exposure and test method. Accordingly, this will lead to a wider possible use of such novel composite materials in external strengthening of RC beams and slabs in the UAE and GCC region.	01/06/2018	31/05/2020	FRG	150000
Development of Concrete Matrix with Hybrid Coarse Aggregate Blend	Sherif Yehia	None	CVE	Concrete structures at the early hydration stages experience different types of shrinkage, which lead to a change in the concrete volume. If the concrete section is restrained, which is the case in most concrete structures, then microstructure and surface cracks will take place. These cracks might have a limited impact on the section carrying capacity, however, they impact the durability and sustainability of the structures. Therefore, different methods of curing are adopted by the construction industry to control cracking at an early age after placing of the concrete. One of the most promising curing methods is the internal curing process. An internal curing agent is added during mixing and moisture is released during the hydration process, maintaining the humidity to avoid early cracking. Lightweight aggregate (LWA) has been considered in many research efforts to evaluate its effectiveness as an internal curing agent. This reseach is a pilot study to verify results of using 50% replacement of LWA to improve concrete durability, in addition, other types of LWA available in the UAE will be included. The evaluation criteria will include workability, consistency, compressive strength and shrinkage.	01/06/2021	31/05/2023	FRG	116250