Durability Of Cfrp Strengthened Concrete Structures Under

Durability of CFRP Strengthened RC Elements in Severe Environments
Proceedings of the Second International RILEM Symposium
Computational Mechanics, Materials and Engineering Applications
Qualitätssicherung bei Stahlbetonsanierungen mit aufgeklebten CFK-Lamellen
FRP Composites in Civil Engineering - CICE 2004
Quality Assurance of Reinforced Concrete Structures Strengthened by Externally Bonded CFRP Strips
Issues in Structural and Materials Engineering: 2013 Edition
Non-Metallic (FRP) Reinforcement for Concrete Structures
Experimental and Numerical Investigations on Bond Durability of CFRP Strengthened Concrete Members Subjected to Environmental Exposure
Developments in fiber-reinforced polymer (FRP) composites for civil engineering
Proceedings of the Tenth International Conference on Bridge Maintenance, Safety and Management (IABMAS 2020), June 28-July 2, 2020, Sapporo, Japan
Durability Analysis of Composite Systems 2001
CIGOS 2017, 26-27 October, Ho Chi Minh City, Vietnam
Advanced Polymer Composites for Structural Applications in Construction
Fiber-Reinforced-Plastic (FRP) Reinforcement for Concrete Structures
Proceedings of an International Conference on Advances in Engineering Structures, Mechanics & Construction, held in Waterloo, Ontario, Canada, May 14-17, 2006
Design Guidelines for Durability of Bonded CFRP Repair/strengthening of Concrete Beams
Durability of Reinforced Concrete Members Strengthened with CFRP Plates and Subjected to Moisture and Salts
Concrete Solutions 2011
Durability of Composites for Civil Structural Applications
Fatigue, Durability, and Fracture Mechanics
Properties and Applications
Cost-effective Practices for Off-system and Local Interest Bridges
Advances in Engineering Structures, Mechanics & Construction
6. Assessing the durability of the interface between fiber-reinforced polymer (FRP) composites and concrete in the rehabilitation of reinforced concrete structures
ACIC 2004
Proceedings of Fatigue Durability India 2019
Maintenance, Safety, Risk, Management and Life-Cycle Performance of Bridges
Proceedings of the 5th International Conference , DURACOSYS 2001, tokyo, 6-9 November 2001
Debonding Failure of Carbon Fiber Reinforced Polymer Reinforced Concrete Beams and In-situ Monitoring Schemes
Bridge Maintenance, Safety, Management, Life-Cycle Sustainability and Innovations
Environmental Durability of Reinforced Concrete Deck Girders Strengthened for Shear with Surface-bonded Carbon Fiber-reinforced Polymer
Environmental Durability of Reinforced Concrete Deck Girders Strengthened with Surface-bonded Carbon Fiber-reinforced Polymer
Proceedings of CICE 2020/2021
Eco-efficient Repair and Rehabilitation of Concrete Infrastructures
Design, Construction and Practical Applications
Proceedings of the Third International Symposium on Materials and Sustainable Development
10th International Conference on FRP Composites in Civil Engineering
Strengthening of Concrete Structures Using Fiber Reinforced Polymers (FRP)

BISHOP SAMIR

Durability of CFRP Strengthened RC Elements in Severe Environments Elsevier
Strengthening reinforced concrete (RC) members using fiber reinforced polymer (FRP) composites through external bonding has emerged as a viable technique to retrofit/repair deteriorated infrastructure. The interface between the FRP and concrete plays a critical role in this technique. This chapter discusses the analytical and experimental methods used to examine the integrity and long-term durability of this interface. Interface stress models, including the commonly adopted two-parameter elastic foundation model and a novel three-parameter elastic foundation model (3PEF) are first presented, which can be used as general tools to analyze and evaluate the design of the FRP strengthening system. Then two interface fracture models – linear elastic fracture mechanics and cohesive zone model – are established to analyze the potential and full debonding process of the FRP–concrete interface. Under the synergistic effects of the service loads and environments species, the FRP–concrete interface experiences deterioration, which may reduce its long-term durability. A novel experimental method, environment-assisted subcritical debonding testing, is then introduced to evaluate this deteriorating process. The existing small cracks along the FRP–concrete interface can grow slowly even if the mechanical load is lower than the critical value. This slow-crack growth process is known as environment-assisted subcritical cracking.

A series of subcritical cracking tests are conducted using a wedge-driven test setup t o gain the ability to accurately predict the long-term durability of the FRP–concrete interface.

Proceedings of the Second International RILEM Symposium

Experimental and Numerical Investigations on Bond Durability of CFRP Strengthened Concrete Members Subjected to Environmental ExposureResults of tensile tests on FRP coupons indicate that both epoxy and polyurethane FRP systems do not degrade significantly under environmental exposure. However, flexural tests on the FRP strengthened concrete beams indicate that bond between FRP and concrete shows significant degradation, especially for aqueous exposure. Moreover, a protective coating suppresses the measured degradation. Also, experimental load-displacement curves for control beams show excellent agreement with numerical load-displacement curves obtained using the proposed bond model. Finally, a bond-slip model is predicted for concrete leachate conditioned beams by matching load-displacement curves for those beams with numerical load-displacement curves.Durability of Carbon Fiber Reinforced Polymer (CFRP) Repair/strengthening Concrete Beams Long-term durability of surface-bonded carbon fiber-reinforced polymer (CFRP) for shear strengthening of reinforced concrete (RC) bridge members remains uncertain due to the limited field experience with these materials. This paper provides experimental results from the testing of full-scale RC bridge girder specimens after exposure to prolonged environmental exposure and combined action of freeze-thaw + repeated service loads. CFRP shear contributions seen in experimental results were estimated using a refined base capacity prediction (Response-2000) and compared to predicted CFRP shear contributions (ACI-440). The IT specimens did not exhibit strength reductions due to moisture exposure, instead the presence of continuous water exposure for the relatively young concrete caused higher concrete tensile properties resulting in increased bond strength. Previous research showed CFRP strengthened T specimens with freeze-thaw exposure exhibited lower shear capacity than similar unexposed CFRP strengthened T specimen. But the current research demonstrated that if the beam is well protected against moisture infiltration at the strip termination, the beam will be less susceptible to freeze-thaw bond deterioration. The orientations of specimens during repair and during exposure are important considerations for environmental durability. The CFRP strip terminations should be focused on during installation to insure well and perhaps extra saturation even past the CFRP material to limit moisture infiltration along this edge.

Computational Mechanics, Materials and Engineering Applications ProQuest

The durability of three types of fiber reinforced polymers (CFRP plate, CFRP fabric, and GFRP fabric) used for strengthening concrete structures was evaluated. Both material and bond specimens were subjected to conditioning treatments that are likely to occur in civil infrastructure. Samples were exposed to 100% humidity, alkalinity, salt water, dry heat, freeze/thaw cycling, vehicle fuel, and UV radiation for various durations and then were tested and compared to baseline sample values to determine if deterioration took place at a material or bond level. The CFRP plate tensile specimens experienced an increase in strength from the benefits of a post-curing period while at the same time experienced a decrease in thickness. The decrease in thickness was most likely due to chemical degradation of the resin matrix, and/or as a result of post-curing. The CFRP fabric experienced a post-curing period for a much shorter duration than the plate. The bond specimens exposed to elevated temperatures, moisture, and chemical solutions suffered an apparent trend of deterioration along the bond line, which progressed into material failure for specimens exposed for longer durations. The GFRP fabric bond specimens followed a trend similar to the CFRP fabric specimens when exposed to moisture and chemical solutions. The rate of deterioration due to the chemical attack of alkalinity was much faster than the attack due to salt water. Reinforced concrete beams strengthened with the three materials were exposed to a combined treatment of freeze/thaw cycling and UV radiation and then tested in flexure and compared to the performance of non-conditioned strengthened beams. The GFRP fabric specimens were the only beams impacted by the conditioning. The treatment resulted in fiber surface pitting and, based on the observed failure modes, increased brittleness of the material.

Qualitätssicherung bei Stahlbetonsanierungen mit aufgeklebten CFK-Lamellen Springer

Strengthening of Concrete Structures Using Fiber Reinforced Polymers (FRP): Design, Construction and Practical Applications presents a best practice guide on the structural design and strengthening of bridge structures using advanced Fiber Reinforced Polymer (FRP) composites. The book briefly covers the basic concepts of FRP materials and composite mechanics, while focusing on practical design and construction issues, including inspection and quality control, paying special attention to the differences in various design codes (US, Japan, and Europe) and recommendations. At present, several design guides from the US, Japan, and Europe are available. These guidelines are often inconsistent and do not cover all necessary design and inspection issues to the same degree of detail. This book provides a critical review and comparison of these guidelines, and then puts forward best practice recommendations, filling a significant gap in the literature, and serving as an important resource for engineers, architects, academics, and students interested in FRP materials and their structural applications. Written from a practitioner's point-of-view, it is a valuable design book for structural engineers all over the world. Includes a large quantity of design examples and structural software to facilitate learning and help readers perform routine design Provides recommendations for best practices in design and construction for the strengthening of bridge structures using advanced fiber-reinforced polymer (FRP) composites Presents comprehensive guidelines on design, inspection, and quality control, including laboratory and field testing information

FRP Composites in Civil Engineering - CICE 2004 Taylor & Francis

Following the success of ACIC 2002, this is the 2nd International Conference focusing on the application and further exploitation of advanced composites in construction held at the University of Surrey in April 2004. With over 100 delegates the conference brought together practicing engineers, asset managers, researchers and representatives of regulatory bodies to promote the active exchange of scientific and technical information on the rapidly changing scene of advanced composites in construction. The aim of the conference was to encourage the presentation of new concepts, techniques and case studies, which will lead to greater exploitation of advanced polymer composites and FRP materials for the civil engineering infrastructure, rehabilitation and renewal.

Thomas Telford

This book presents the proceedings of an International Conference on Advances in Engineering Structures, Mechanics & Construction, held in Waterloo, Ontario,

Canada, May 14-17, 2006. The contents include contains the texts of all three plenary presentations and all seventy-three technical papers by more than 153 authors, presenting the latest advances in engineering structures, mechanics and construction research and practice.

Quality Assurance of Reinforced Concrete Structures Strengthened by Externally Bonded CFRP Strips CRC Press

Abstract: The use of carbon fiber reinforced polymers (CFRP) into the repair and retrofitting of concrete structures has been growing exponentially over the past two decades worldwide. The composite offers a superior strength- to- weight ratio as well as good durability in various service environments. The proper implementation of CFRP system involves a clean concrete surface, a powerful adhesive, such as epoxy resins together with compatible CFRP. However, one of the limiting factors towards the widespread of CFRP systems is attributed to its low resistance to elevated temperature and fire. Hence, efforts have been exerted to better understand and quantify this negative effect and to provide external protection for the system in order to alleviate the negative of impact of elevated temperature. This study focuses on assessing the impact of elevated temperature on the flexural strength of externally bonded CFRP with and without protection. Two sets of plain concrete beams have been prepared without protection and with a ready-to-use cementitious protective. All beams were subjected to temperature degrees of 70, 120 and 180 °C for 1, 2, 4 and 8 hours in a furnace. The flexural strength and mode of failure have been assessed for each set. The results of this work demonstrate the CFRP strengthened beams experienced a drastic loss in strength upon exposure to elevated temperature. The extent of the drop in strength varied according to degree of exposure as well as duration. On the whole, CFRP unprotected beams were able to restore 40% of the flexural strength at 70 °C, while the CFRP strengthened protected beams restored 20% of the flexural strength of the CFRP strengthened beams. At exposure of 120 °C the CFRP strengthened beams showed increase in the flexural strength of 40% over unstrengthened unprotected beams. The CFRP strengthened protected beams surpassed the flexural strength of the CFRP strengthened beams at 120 °C by 20%. At exposure of 180 °C, the CFRP strengthened protected and unprotected beams failed to restore the lost flexural strength for the four and eight hours of exposure. This was followed by the appearance of the normal flexural crack on all the beams. Yet, the separation of the CFRP laminates from the concrete surface were noticed only at exposure to temperatures of 120 and 180 °C. The preliminary cost of the CFRP strengthened unprotected was estimated as 90% higher than the unstrengthened unprotected beams and the CFRP strengthened protected assessed as 16% higher than the CFRP strengthened unprotected. The results unveiled the ability of the CFRP strengthened beams to enhance the flexural strength upon exposure to elevated temperature along with the ability of the fire protection system to further improve this strength. Future work should be resumed to investigate wider sets of composites, various temperatures schemes, long term properties as well as applying the system to steel reinforced beams. It is also recommended to investigate the cooling effect on the performance of the strengthened and protected beams.

Issues in Structural and Materials Engineering: 2013 Edition Springer Nature

"This research investigated the durability of carbon-fiber-reinforced polymer composites (CRFP) used for shear strengthening reinforced concrete deck girders. Large beams were used to avoid accounting for size effects in the data analysis. The effort included determining the role of freeze-thaw, moisture, and fatigue of structural performance and developing analytical design procedures that account for durability"--Technical report documentation page.

Non-Metallic (FRP) Reinforcement for Concrete Structures Springer Nature

"Advances in FRP Composites in Civil Engineering" contains the papers presented at the 5th International Conference on Fiber Reinforced Polymer (FRP) Composites in Civil Engineering in 2010, which is an official conference of the International Institute for FRP in Construction (IIFC). The book includes 7 keynote papers which are presented by top professors and engineers in the world and 203 papers covering a wide spectrum of topics. These important papers not only demonstrate the recent advances in the application of FRP composites in civil engineering, but also point to future research endeavors in this exciting area. Researchers and professionals in the field of civil engineering will find this book is exceedingly valuable. Prof. Lieping Ye and Dr. Peng Feng both work at the Department of Civil Engineering, Tsinghua University, China. Qingrui Yue is a Professor at China Metallurgical Group Corporation.

Experimental and Numerical Investigations on Bond Durability of CFRP Strengthened Concrete Members Subjected to Environmental Exposure Springer Science & Business Media

The third International Symposium on Materials and Sustainable Development ISMSD2017 (CIMDD2017) will include a 2-day Conferences (07 & 08 November). Organized by the Research Unit: Materials, Processes and Environment and University M'hamed Bougara of Boumerdes, this symposium follows the success of CIMDD 2013-2015 and continues the traditions of the highly successful series of International Conferences on the materials, processes and Environment. The Symposium will provide a unique topical forum to share the latest results of the materials and sustainable development research in Algeria and worldwide.

Developments in fiber-reinforced polymer (FRP) composites for civil engineering diplom.de

Eco-efficient Repair and Rehabilitation of Concrete Infrastructures provides an updated state-of-the-art review on eco-efficient repair and rehabilitation of concrete infrastructure. The first section focuses on deterioration assessment methods, and includes chapters on stress wave assessment, ground-penetrating radar, monitoring of corrosion, SHM using acoustic emission and optical fiber sensors. Other sections discuss the development and application of several new innovative repair and rehabilitation materials, including geopolymer concrete, sulfoaluminate cement-based concrete, engineered cementitious composites (ECC) based concrete, bacteria-based concrete, concrete with encapsulated polyurethane, and concrete with super absorbent polymer (SAPs), amongst other topics. Final sections focus on crucial design aspects, such as quality control, including lifecycle and cost analysis with several related case studies on repair and rehabilitation. The book will be an essential reference resource for materials scientists, civil and structural engineers, architects, structural designers and contractors working in the construction industry. Delivers the latest research findings with contributions from leading international experts Provides fully updated information on the European standard on materials for concrete repair (EN 1504) Includes an entire sections on the state-of-the-art in NDT, innovative repair and rehabilitation materials, as well as LCC and LCA information

Proceedings of the Tenth International Conference on Bridge Maintenance, Safety and Management (IABMAS 2020), June 28-July 2, 2020, Sapporo, Japan Trans Tech Publications Ltd
This proceedings covers the general problem related to the damage initiation and development, the failure criteria and the specific aspects related to fatigue, creep behaviour, moisture diffusion and the problem of the joining systems.
Durability Analysis of Composite Systems 2001 Elsevier Inc. Chapters
The Concrete Solutions series of International Conferences on Concrete Repair began in 2003, with a conference held in St. Malo, France in association with INSA Rennes, followed by the second conference in 2006 (with INSA again, at St. Malo, France), and the third conference in 2009 (in Padova and Venice, in association with the University of Padova). Now in 2011, the event is being held in Dresden in Germany and has brought together some 112 papers from 33 countries. Whereas electrochemical repair tended to dominate the papers in earlier years, new developments in structural strengthening with composites have been an increasingly important topic, with a quarter of the papers now focusing on this area. New techniques involving Near Surface Mounted (NSM) carbon fibre rods, strain hardening composites, and new techniques involving the well established carbon fibre and polyimide wrapping and strengthening systems are presented. Seventeen papers concentrate on case studies which are all-important in such conferences, to learn about what works (and what doesn't work) on real structures. Thirteen papers are devoted to new developments in Non-Destructive Testing (NDT). Other topics include service life modelling, fire damage, surface protection methods and coatings, patch repair, general repair techniques and whole life costing. This book is essential reading for anyone engaged in the concrete repair field, from engineers, to academics and students and also to clients, who, as the end user, are ultimately responsible for funding these projects and making those difficult decisions about which system or method to use.
CIGOS 2017, 26-27 October, Ho Chi Minh City, Vietnam Woodhead Publishing
- Introduction - Design specification - Design process overview - Design of composite - Structural design - Implementation - Tests - Verification - Monitoring - References Reviews Fibre reinforced polymer (FRP) composites have been used for many years in the aircraft and shipbuilding industries. They are now being used in a variety of construction applications where their light weight, high strength, stiffness, durability, and ease of installation makes them cost effective. This is particularly true in the repair and rehabilitation of existing infrastructure. This book provides design guidance on the use of fibre reinforced polymer composites, based on the results of two major programmes funded by the DETR. The book demonstrates that fibre reinforced polymer composites can be used with complete confidence in structural applications. Likewise, guidance is given on short-term and long-term behaviour and how this can be interpreted within a factual design situation. Also included are case studies of projects on the London Underground network, alongside contributions from industry research groups. FRP composites can offer a performance or cost benefit over traditional solutions. As there are no official standards for this type of work, this first attempt at producing design recommendations will be a vital resource for structural engineers. Quality Concrete, October 2001
Advanced Polymer Composites for Structural Applications in Construction CRC Press
Issues in Structural and Materials Engineering: 2013 Edition is a ScholarlyEditions™ book that delivers timely, authoritative, and comprehensive information about Computer Engineering. The editors have built Issues in Structural and Materials Engineering: 2013 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Computer Engineering in this book to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Structural and Materials Engineering: 2013 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at http://www.ScholarlyEditions.com/.
Fiber-Reinforced-Plastic (FRP) Reinforcement for Concrete Structures LAP Lambert Academic Publishing
Volume is indexed by Thomson Reuters CPCI-S (WoS). Following the great progress made in Computational Mechanics and Materials, the 2011 International Workshop on Computational Mechanics, Materials and Engineering Applications (CMMEA 2011) aimed at providing a forum for the presentation and discussion of state-of-the-art developments in Computational Mechanics and Engineering Applications, Building Materials, Geotechnical & Soil Engineering and Materials Science and Engineering Applications. The emphasis was placed on basic methodologies, scientific developments and engineering applications.
Proceedings of an International Conference on Advances in Engineering Structures, Mechanics & Construction, held in Waterloo, Ontario, Canada, May 14-17, 2006 Woodhead Publishing
This volume highlights the latest advances, innovations, and applications in the field of FRP composites and structures, as presented by leading international researchers and engineers at the 10th International Conference on Fibre-Reinforced Polymer (FRP) Composites in Civil Engineering (CICE), held in Istanbul, Turkey on December 8-10, 2021. It covers a diverse range of topics such as All FRP structures; Bond and interfacial stresses; Concrete-filled FRP tubular members; Concrete structures reinforced or pre-stressed with FRP; Confinement; Design issues/guidelines; Durability and long-term performance; Fire, impact and blast loading; FRP as internal reinforcement; Hybrid structures of FRP and other materials; Materials and products; Seismic retrofit of structures; Strengthening of concrete, steel, masonry and timber structures; and Testing. The contributions, which were selected by means of a rigorous international peer-review process, present a wealth of exciting ideas that will open novel research directions and foster multidisciplinary collaboration among different specialists.
Design Guidelines for Durability of Bonded CFRP Repair/strengthening of Concrete Beams Woodhead Publishing
This book presents selected papers presented during Fatigue Durability India 2019. The contents of this volume discuss advances in the field of fatigue, durability, and fracture, and cover mechanical failure and its applications. The chapters cover a wide spectrum of topics, including design, engineering, testing and computational evaluation of the components or systems for fatigue, durability, and fracture mechanics. The contents of this book will appeal not only to academic researchers, but also to design engineers, failure

analysts, maintenance engineers, certification personnel, and R&D professionals involved in a wide variety of industries.

Durability of Reinforced Concrete Members Strengthened with CFRP Plates and Subjected to Moisture and Salts CRC Press

Externally bonded CFRP composite plates showed a great potential in the area of structural rehabilitation, and impressive applications have been reported. However, there are heightened concerns related to the overall durability under harsh environmental conditions. In aggressive environments, CFRP retrofitted systems are subjected to moisture, salts, ultraviolet radiations and high temperatures, which not only causing steel to corrode and concrete to deteriorate, but it may degraded the adhesive bond, hence limiting the strength of the retrofitted system. This is evident, since, at best, an insufficient bond renders the external reinforcement as ineffective as it is the mean to transfer stresses between the adherents. This study intends to examine the durability of the adhesive bond under accelerated laboratory conditions that mimic harsh environmental conditions, and under severe real-life environments that are prevalent at the Middle East countries, particularly at the Dead Sea and Aqaba regions of Jordan.

Concrete Solutions 2011 Transportation Research Board

Dealing with a wide range of non-metallic materials, this book opens up possibilities of lighter, more durable structures. With contributions from leading international researchers and design engineers, it provides a complete overview of current knowledge on the subject.