FRP INTERNATIONAL

the official newsletter of the International Institute for FRP in Construction

Vol. 19, No. 2 Decemeber, 2022

IIFC has a website:

WWW.IIFC.ORG

Table of Contents

Message from the Editor

In this issue, we have the report from the conference FRPRCS-15 and APFIS 2022, which was held on 10-14 December 2022 via Zoom. This was a successful conference for the FRP research community. CICE 2023 in Brazil and FRPRCS-16 in USA will follow and everyone is welcome to participate. Next year, we are very excited to celebrate the IIFC 20th anniversary. A special issue –the IIFC 20th anniversary in ASCE Journal of Composites for Construction is planned. A Virtual Special Issue - Novel Structures Incorporating FRP Composites in the Elsevier journal of Engineering Structures is calling for submissions. Two important codes CEN/TS 19101: 2022 "Design of fibre-polymer composite structures" and ACI CODE-440.11-22 "Building Code Requirements for Structural Concrete Reinforced with GFRP Bars" are introduced.

If you like to share your ideas and information, please send your submissions to fengpeng@tsinghua.edu.cn

President's Message

This final issue of the IIFC Newsletter for 2022 updates us on a busy year that we have had in the composites in construction community. Key documents have been published, such as the first comprehensive building code covering the use of GFRP reinforcing bars in structural concrete applications (American Concrete Institute), as well as a European Technical Specification on the design of fibre-polymer composite structures (European Committee for Standardization). These are most important documents that will facilitate rigorous design in the practical application of FRP composites in the built environment. Members of our IIFC community have been involved for extended periods of time in these two projects – congratulations and thank you to all involved.

A most successful FRPRCS-15 & APFIS-2022 conference was held in December and we are indebted to the organisers (under the leadership of Professor Jian-Fei Chen) for organising such a successful online conference. The two design documents and the FRPRCS-APFIS conference are but some examples of the core aim of IIFC being realised, namely "to advance the understanding and the application of fibre-reinforced polymer (FRP) composites in the civil engineering infrastructure, in the service of the engineering profession and society.".

During the year, Professor Larry Bank announced his retirement and has resigned from active IIFC duties. Larry has been a driving force in the composites in construction community for over three decades and he has served in multiple capacities in multiple organisations (e.g. IIFC, ASCE, ACI) for many years. He was the founding Editor-in-Chief of the Journal of Composites for Construction, ASCE, in 1997. In addition, his papers and books must be required reading for researchers and practitioners in the field. Larry's contributions to IIFC have been significant and numerous – selected highlights being one of the founders of IIFC back in 2003, an IIFC Fellow since 2004, a former President (2010-2014), the 2012 IIFC Medallist, a member of the Advisory Committee since 2014, and a regular attendee of and contributor to IIFC conferences. He has been a colleague, mentor and friend to many. On behalf of IIFC, I would like to thank Larry dearly for his years of service to our FRP community. Happy retirement, Larry!

Looking ahead, best wishes for a most enjoyable and relaxing end of year festive season. Please use the time to recharge the batteries and prepare yourselves for what is going to be a fantastic 2023, as the world continues to open up. Our flagship conference, CICE, will be held face to face next year in Brazil in July, and this will be the first official IIFC conference to be held in person since FRPRCS in 2019 in Belfast. This will also be the first time that an IIFC conference has been held in Latin America. I am really looking forward to catching up with old friends and also making new friends next year.

Stay safe.

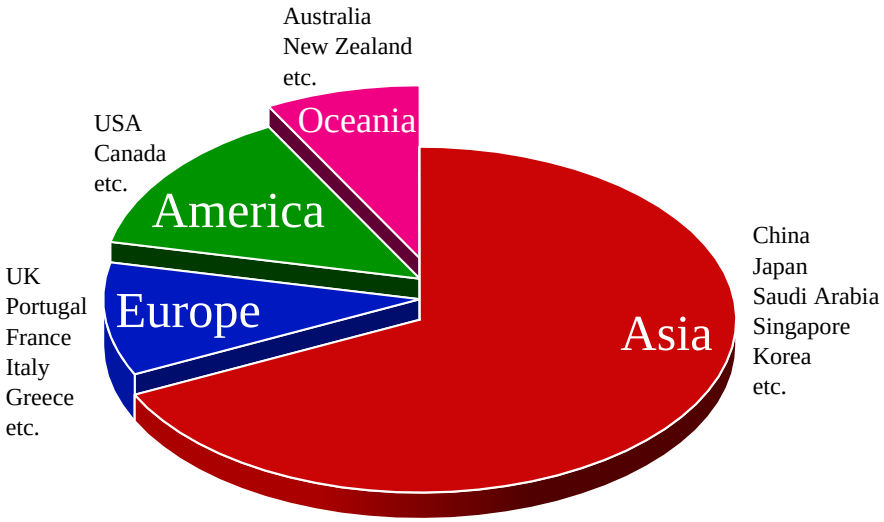
Yours Sincerely,
Scott Smith
IIFC President
The University of Adelaide, Australia

Report of FRPRCS-15 & APFIS-2022

The 15th International Conference on Fibre-Reinforced Polymers for Reinforced Concrete Structures (FRPRCS-15) and the 8th Asia-Pacific Conference on FRP in Structures was held on 10-14 December 2022 via Zoom. The joint-conference was hosted by Southern University of Science and Technology (SUSTech), and co-hosted by The Hong Kong Polytechnic University, Shenzhen University, South China University of Technology and Huazhong University of Science and Technology. FRPRCS is the longest running conference series on the application of FRP in civil construction. The series was commenced in Vancouver in 1993 and the previous edition was held in Belfast, UK in 2019. FRPRCS has been one of the two official conference series of the International Institute for FRP in Construction (IIFC) since 2018 (the other is the CICE series). APFIS was until 2018 the official IIFC conference of the Asia-Pacific Region, commenced in Hong Kong in 2007 and the previous edition was held in Gold Coast, Australia in 2019. FRPRCS-15 & APFIS-2022 has provided a platform for researchers, engineers, practitioners and other relevant stakeholders to communicate and exchange thoughts about the frontiers and practical developments of FRP reinforcement for concrete, masonry, metallic

and other structures, and foster further international collaborations.

The joint-conference attracted around 500 registered participants from 18 countries. The distribution of origins of presented papers by countries and continents are shown below.



The official program featured 15 scientific sessions and 234 presentations including Keynote lectures and Invited Presentations. The scientific sessions were simultaneously organized as 2 parallel sessions. The program consisted of 8 mini-symposia.

The 8 keynote presentations, in the order of presentation at the conference, are as follows:

Jin-Guang Teng
The Hong Kong
Polytechnic University

FRP-seawater sea-sand concrete (SSC) structures: Their beginning, current status and associated innovations

Zhishen Wu
Southeast University

Innovative applications of basalt FRP composites in high performance structures

Brahim Benmokrane University of Sherbrooke 	Weichen Xue Tongji University 
FRP reinforcement for sustainable and resilient concrete structures: Research, design codes and applications	Bond properties between GFRP rebars and UHPC
Scott Smith The University of Adelaide 	Peng Feng Tsinghua University 
FRP composites for off-earth construction applications	Tailorable multi-scale fiber reinforced cementitious composites: Strength, ductility, and cracking
Guijun Xian Harbin Institute of Technology 	João R. Correia University of Lisbon 
New fiber reinforced polymer composites for construction	Fire behaviour of FRP-reinforced concrete structures

The 8 mini-symposia are as follows:

FRP Applications in Marine and Offshore Construction Organizers: Jiafei Jiang and Yufei Wu	FRP-enabled Hybrid Structures Organizers: Tao Yu, Shishun Zhang and Bing Zhang

FRP Applications in Bridges: Strengthening and New Construction Organizers: Guang-Ming Chen and Yufei Wu	FRCM Systems for the Strengthening of Masonry Structures Organizers: Jennifer D'Anna, Lidia La Mendola, Marianovella Leone, Giovanni Minafò, and Alessia Monaco
Fibre Reinforced Polymers (FRP) in Pre-stressing Applications Organizers: S. Matthys, M. Guadagnini and M.A. Yaqub	Advanced Cementitious Materials with FRP/Fibre Textile Reinforcement Organizers: Junjie Zeng, Guan Lin, and Yan Zhuge
Applications of FRP and New Materials in Structures under Static and Dynamic Loading Organizers: Thong Pham and Weiqiang Wang	GFRP as Internal Reinforcement of Building Structures – Principles and Use of the ACI 440.11-22 Code Organizer: Antonio Nanni

CICE2023
RIO DE JANEIRO - BRAZIL

11TH INTERNATIONAL CONFERENCE ON FRP COMPOSITES IN CIVIL ENGINEERING

Conference co-chairs:

Dr. Daniel Cardoso, Pontifical Catholic University of Rio de Janeiro (PUC-Rio)

Prof. Kent A. Harries, University of Pittsburgh

please contact us with any questions

CICE 2023 in Rio!

Make plans now to attend our first face-to-face meeting in five years!

The 11th International Conference on FRP Composites in Civil Engineering (CICE 2023) will be held in Rio de Janeiro 23-26 July, 2023. All information on the conference and venue (Fairmont Rio – Copacabana) can be found at cice2023.org. Registration will open January 2023.

The conference organisers are planning a dynamic technical programme and will be drawing in a few themes new to CICE. Special sessions on newly developed FRP Codes and Standards from the US and EU will feature. Additional focus on textile-reinforced concrete (TRM), including a RILEM committee meeting will be held. A robust social programme is also planned so that we can all re-establish old friendships and initiate new ones.

Conference Venue: Fairmont Rio-Copacabana

The organisers are pleased to announce CICE 2023 keynote speakers; some of whom will be introducing new expertise and ideas to the IIFC community:

- Kim Pickering, Waikato University, New Zealand
- Sandro Amico, Federal University of Rio Grande do Sul, Brazil
- Brahim Benmokrane, University of Sherbrooke, Canada
- Justine Beauson, Technical University of Denmark, Denmark
- Barzin Mobasher, Arizona State University, USA
- and the IIFC Medal and Young Investigator honourees

The conference proceedings will be Open Access and each paper will receive a unique DOI making it easily found, downloaded and cited. Peer review and publication will be on a rolling basis through the first half of 2023; papers submitted and reviewed early, will be published prior to the conference; ***get your paper submitted early!***

The deadline for abstract submission is 31 December 2022, but we will accept submissions from IIFC members through January.

Visit cice2023.org for regular updates on the conference

From sea to sky in beautiful Rio de Janeiro

Welcome to FRPRCS-16 and call for papers

The 16th International Symposium on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures (FRPRCS) is organized by ACI Committee 440 and held on March 23 and 24, 2024 at the ACI Spring 2024 convention in New Orleans, Louisiana, USA. FRPRCS-16 will attract interest from researchers, practitioners, and manufacturers involved in the use of FRPs as reinforcement for concrete and masonry structures. This includes the use of FRP reinforcement in new construction and FRP for strengthening and rehabilitation of existing structures.

The papers/presentations not only will emphasize the experimental, analytical, and numerical validations of using FRP composites but also will aimed at providing insights needed for improving existing guidelines and developing design codes. New frontiers of FRP research were explored that provide information on emerging materials, systems, and applications for extreme events such as fire and earthquakes. The technical papers will also feature discussions on sustainability, novel applications, new technologies, and long-term field data that will result in greater acceptance and use of FRP composites technology by practitioners.

Conference Co-Chairs:

Dr. Ayman M. Okeil (Louisiana State University, USA)

Dr. Pedram Sadeghian (Dalhousie University, Canada)

Dr. John J. Myers (Missouri University of Science and Technology, USA)

Dr. Maria D. Lopez (Modjeski and Masters Inc., USA)

List of Topics:

- FRP Materials: Properties, Tests and Standards
- Strengthening of Concrete Structures using FRP Systems
- FRP Reinforcement of Concrete Structures Seismic Resistance of FRP-
- Reinforced/Strengthened Concrete Structures
- Advances in Uses of FRP in Masonry Structures
- Behavior and Design of FRP Prestressed Concrete Structures
- Effects of Extreme Events on FRP Reinforced/Strengthened Concrete/Masonry Structures
- FRP Bond and Anchorage in Concrete Structures
- Durability of FRP Systems
- Knowledge Gaps on Performance of FRP Systems in Structures
- Emerging FRP Systems
- FRP Design Codes and Guidelines
- Successful Applications of FRP in Large Infrastructure Projects

Abstract Submission:

Extended Abstract including text, tables, figures and keywords should be no more than TWO pages.

Abstract Submission Deadline: Jan. 15, 2023

Full-length papers upon abstract acceptance are due Jun. 1, 2023.

Please use the abstract template below and submit a PDF of the file via the link below:

www.frprcs16.com/templates

Publication:

FRPRCS-16 proceedings will be published as an ACI Special Publication. All papers must be original and not simultaneously submitted to another journal or conference.

Venue:

The conference will be held on March 23 and 24, 2024 at the ACI Spring 2024 convention in New Orleans, Louisiana, USA.

Contact:

All questions about submissions should be emailed to frprcs16@gmail.com

Sponsors:

American Concrete Institute
Always advancing

Call for papers: JCC Special Issue - IIFC 20th anniversary

Dear IIFC Members and Colleagues:

The year 2023 marks the 20th anniversary of the IIFC. To commemorate and celebrate this important milestone, the IIFC in collaboration with the ASCE Journal of Composites for Construction is planning a dedicated Special Collection of the journal. The theme of the collection is 'New Frontiers of FRP in Construction and Pathways towards Implementation.'

Topics for this collection include but are not limited to:

- Advanced technologies of composites for construction such as additive manufacturing and 3D printing,
- Green composites including bio-based resins and natural fibers,
- Sustainability and recycling,
- Hybrid structures and materials,
- FRP-seawater seasand concrete structures,
- New insights into durability and fire resistance,
- Space structures,
- Case studies and field applications.

There will also be a collection of invited forums "short articles" related to the perspective for tomorrow, as well as vision and reflections by leaders in key areas.

IIFC members are invited to submit manuscripts to this Special Collection, which will then go through the standard peer-review process of the journal. From the collection of the submitted papers, the Guest Editors will select a group of papers that best fits the theme of the Special Collection. The remaining accepted papers will be published regularly by the journal.

The timeline is as follows:

- Full papers are due June 15, 2023
- First round of reviews is expected to be completed and outcome communicated to authors by August 2023
- Revised manuscripts are expected to be submitted by authors by September 2023
- Final decisions are expected to be made by November 2023

Invited manuscripts must be prepared according to ASCE's guide for authors (https://ascelibrary.org/doi/book/10.1061/9780784479018), and submitted through the journal's Editorial Manager website (https://www.editorialmanager.com/jrncceng

/). Authors should indicate in the submission questions that the invited manuscript is being submitted for the "Special Collection for the 20th Anniversary of the IIFC (Guest Editor: Dr. Amir Fam; Co-Guest Editors: Dr. João Correia and Dr. Tao Yu)".

Thank you, and we look forward to receiving your submissions.

Amir Fam,
Lead Guest-Editor (Americas)
IIFC Senior Vice President, Queen's University, Canada
Associate Editor, ASCE *Journal of Composites for Construction*

João R. Correia,
Co-Guest-Editor (Europe, Africa and the Middle East)
IIFC Webmaster, University of Lisboa, Portugal
Associate Editor, ASCE *Journal of Composites for Construction*

Tao Yu,
Co-Guest-Editor (Asia-Pacific)
IIFC Secretary, The Hong Kong Polytechnic University, China
Associate Editor, ASCE *Journal of Composites for Construction*

Call for papers: JEST VSI in FRP Structures

Special Issue in Novel Structures Incorporating FRP Composites

Fibre-reinforced polymer (FRP) composites consist of continuous fibres embedded in a polymeric matrix, and are well known for their many advantages including the excellent corrosion resistance, high strength-to-weight ratio and tailorability in material properties. As a result, the infrastructure applications of FRP composites have increased tremendously over the past three decades. The use of FRP was initially explored in the strengthening of existing structures, and more recently in the construction of high-performance new structures. In the area of strengthening, externally bonded FRP reinforcement is now a mainstream technology, while extensive research is continuing on innovative strengthening methods. In the area of new construction, many innovative structural forms enabled by composites are being explored, including all FRP structures, FRP-reinforced concrete structures and hybrid structures of FRP and other materials.

We are calling for paper submission to this special issue of Novel Structures Incorporating FRP Composites to be published in Engineering Structures, the top international journal on Structural Engineering. The special issue is dedicated to the recent scientific progress and technological advances on the infrastructure applications of FRP composites with a particular focus on novel structures incorporating FRP. To align with the scope of the journal, papers mainly on materials research will not be accommodated in this special issue and unfortunately be declined. Topics of interest include, but are not limited to:

- FRP materials/products for novel structures
- Textile composites for novel structures
- Concrete-filled FRP tubular members
- All-FRP structures
- Concrete structures reinforced or pre-stressed with FRP
- Hybrid structures combining FRP with other materials
- FRP-seawater sea-sand concrete structures

Original research papers or review articles are welcome. Submission to this SI is open to ALL plus by invitation. All submissions will go through the same rigorous peer review process as the normal issue.

Guest editors:

Prof. Tao YU

The Hong Kong Polytechnic University, China

Email: tao-cee.yu@polyu.edu.hk

Prof. Yan ZHUGE

University of South Australia, Australia

Email: Yan.Zhuge@unisa.edu.au

Prof. João Ramôa CORREIA

University of Lisbon, Portugal

Email: joao.ramoa.correia@tecnico.ulisboa.pt

Prof. Yail Jimmy KIM

University of Colorado Denver, USA

Email: jimmy.kim@ucdenver.edu

Prof. Jian-Fei CHEN

Southern University of Science and Technology, China

Email: chenjf3@sustech.edu.cn

Manuscript submission information:

When submitting your manuscript please choose the special issue "**VSI: Novel FRP Structures**" from the choice of submission types. The manuscript should comply with the limit of no more than 30 pages for a research paper and 40 pages for a review paper (Standard page, double line spacing, font size 12) including all sections except references. Please visit the journal website for additional notes for the authors.

The submission is open by December 20, 2022.

The deadline for submission of manuscripts is July 31, 2023.

Authors wishing to submit a review article to the journal should first contact the Special Issues Editor with a proposal, including a description/abstract, list of all authors, corresponding author's CV and a list of the work they have done or published in the area of the review paper. The Editors will assess this proposal and invite the author to submit if they feel the proposal/topic is of interest for the journal and has high-level technical merits.

Engineering Structures is publishing special issues in the new format where special issue articles are published in regular issues as soon as they are available, and simultaneously being grouped online under a specific special issue link, which is easily accessible and navigable on ScienceDirect. Please note that papers solicited through this call will undergo standard journal peer review process and will be indexed for citations like other regular journal papers. All interested authors can submit papers to the special issue through the online journal submission system at EM system:

https://www.editorialmanager.com/engstruct

Learn more about the benefits of publishing in a special issue:

https://www.elsevier.com/authors/submit-your-paper/special-issues

Interested in becoming a guest editor? Please inquire the Special Issues Editor of Engineering Structures (Prof. Peng Feng, Email: fengpeng@tsinghua.edu.cn) and discover the benefits of guest editing a special issue and the valuable contribution that you can make to your field:

https://www.elsevier.com/editors/role-of-an-editor/guest-editors

Publication of the new European Technical Specification CEN/TS 19101: 2022

"*Design of fibre-polymer composite structures*"

João R. Correia (University of Lisbon),
Thomas Keller (EPFL),
Jan Knippers (University of Stuttgart),
Toby Mottram (University of Warwick),
Carlo Paulotto (Ferrovial),
José Sena-Cruz (University of Minho),
Luigi Ascione (University of Salerno)

Introduction

In July 2022, the European Technical Specification CEN/TS 19101: 2022, "Design of fibre-polymer composite structures" was approved by the Technical Committee 250 (TC 250) of the European Committee for Standardization (CEN). This Technical Specification was published in November 2022, constituting a very relevant milestone for the use of fibre-polymer composites in civil engineering structures.

Stages of development

In 2010, the European Commission assigned CEN/TC 250 the task of developing a new generation of Eurocodes. During this review phase of the first generation of Eurocodes, CEN/TC 250 decided to initiate the development of a future Eurocode for fibre-polymer composite structures and, for that purpose, created the working group WG4 "Fibre Reinforced Polymer" (convenor, Luigi Ascione).

In accordance with CEN/TC 250 procedures, the development of a new Eurocode includes three phases: (i) the publication of a Technical and Scientific Report; (ii) the publication of a Technical Specification; and, after a period of trial use, (iii) the conversion of the Technical Specification into Eurocode.

Between 2010 and 2016, the WG4 of CEN/TC 250 developed the Technical and Scientific Report "*Prospect for New Guidance in the Design of FRP*" (Figure 1), which constituted the first phase (of three)

for the development of the future Eurocode. In 2016, this document was approved by CEN/TC 250, in a Formal Vote process, in which a set of aspects requiring further development in the next phase were identified.

The second phase took place between July 2018 and October 2021, with the appointment of Project Team WG.T2 (João R. Correia (leader), Thomas Keller, Jan Knippers, Toby Mottram, Carlo Paulotto, Till Vallée, José Sena-Cruz), who worked on the development of the Technical Specification in close coordination with members of WG4 of CEN/TC 250. After the preparation of several drafts, between January 2020 and April 2021, which were considered by and received feedback from the national standardization bodies (NSBs) of CEN/TC 250, WG4 decided to initiate a Ballot Process in July 2021 and proceed to a Formal Vote process in November 2021. In July 2022, the final draft was finally subjected to the Formal Vote by the NSBs and it was approved by unanimity.

It is worth referring that in order to more properly characterize and to give a better identity to composite materials, the term ''fibre-reinforced polymers'' has been replaced by ''fibre-polymer composites'' or just ''composites''; thus, the acronym ''FRP'' is not used anymore. This change was supported by the European composites industry.

Scope

The Technical Specification CEN/TS 19101: 2022 applies to buildings, bridges and other civil engineering structures, permanent or temporary. It applies to structures made exclusively of fiber-polymer composite materials and to hybrid structures, resulting from the combination of components made of composite materials with components made of other structural materials.

The Technical Specification covers three main types of components in composite materials: (i) laminates (used, for example, as plates or shells); (ii) profiles; and (iii) sandwich panels. These composite components can be made of different types of fibers (glass, carbon, basalt, aramid) and thermosetting resins; in the case of sandwich panels, polymeric foams and balsa wood are considered as core materials.

Regarding connections, CEN/TS 19101: 2022 applies to bolted, bonded (with thermosetting adhesives) and hybrid (bolted and bonded) connections.

CEN/TS 19101: 2022 does not apply to fiber-polymer composite cables, reinforcing bars or strengthening systems, in particular, those used in reinforced concrete structures, which, in the near future, should be covered by new annexes to EN 1992-1-1 (commonly referred to as Eurocode 2). CEN/TS 19101: 2022 also does not apply to special structures, such as buried pipes (for the transport of fluids under pressure), pressure vessels, tanks or chemical storage containers, which are already covered by specific European standards.

It should also be mentioned that CEN/TS 19101: 2022 applies to fiber-polymer composite structures whose temperature in service varies between -40 ºC and (T_g – 20 ºC), T_g being the glass transition temperature of the material (defined based on dynamic mechanical analysis, from the onset value of the storage modulus decay).

Structure

The structure of CEN/TS 19101: 2022 (Figure 2) is consistent with that of the new generation of Eurocodes, thus presenting the same sequence of main clauses. The document, with a total of 238 pages, includes the following 12 clauses and 5 annexes (3 informative and 2 normative):

1. Scope
2. Normative references
3. Terms, definitions and symbols
4. Basis of design
5. Materials
6. Durability
7. Structural analysis
8. Ultimate limit states
9. Serviceability limit states
10. Fatigue
11. Detailing
12. Connections and joints

A. Creep coefficients (informative)

B. Indicative values of material properties for preliminary design (informative)

C. Buckling of orthotropic laminates and profiles (normative)

D. Structural fire design (normative)

E. Bridge details (informative)

Commentary

In addition to CEN/TS 19101: 2022, a Commentary document was prepared (Figure 3), consisting of about 400 background reports (in total, about 1000 pages), corresponding to relevant paragraphs of the Technical Specification (TS). In this document, supplementary information is presented compared to that provided in the TS (some of which resulted from additional research on specific aspects), the options followed are justified and all references that were considered in the TS are properly introduced and cited; this makes it possible to track the options followed and the values adopted, which, if necessary, can be (more easily) revised in the future. Where applicable, this Commentary document also identifies future research needs, which may result in improvement or greater completeness of the provisions currently provided in the TS.

Worked Examples

Alongside the Commentary document, a second complementary document was produced with Worked Examples (Figure 4), which had two objectives: (i) in the TS preparation phase, to test the consistency and completeness of the provisions provided in different clauses and paragraphs; (ii) in the implementation phase, to provide designers with application examples that allow illustrating the use of the TS. The document (with around 400 pages) includes a total of 15 examples, organized into two groups: (i) examples “Type A”, more detailed (presented step by step), at the structural element or connection level; and (ii) examples “Type B”, less detailed, at the structure level.

Figure 1. JRC Science and Policy Report "Prospect for New Guidance in the Design of FRP" (2016).

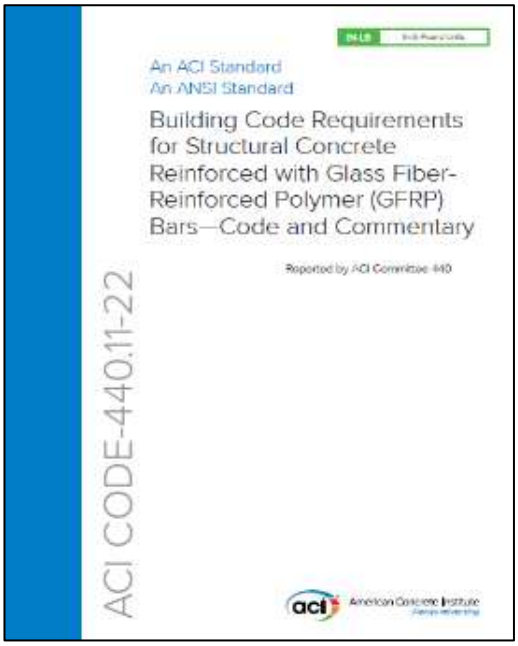
Figure 2. Technical Specification CEN/TS 19101: 2022, "Design of fibre-polymer composite structures".

Figure 3. Commentary to CEN/TS 19101: 2022.

Figure 4. Worked Examples of CEN/TS 19101: 2022.

American Concrete Institute
Always advancing

ACI Publishes Updated Code Requirements for GFRP Bars



The American Concrete Institute, through the work of ACI Committee 440, has released an updated ACI CODE-440.11-22: Building Code Requirements for Structural Concrete Reinforced with Glass Fiber-Reinforced Polymer (GFRP) Bars. The code was developed by an ANSI-approved consensus process and addresses structural systems, members, and connections, including cast-in-place, precast, nonprestressed, and composite construction.

This is the first comprehensive building code covering the use of non-metallic, GFRP reinforcing bars in structural concrete applications. GFRP reinforcement has been in use for decades as an alternative to steel reinforcement because of its non-corrosive, non-magnetic, and lightweight properties. This code mirrors ACI CODE 318-19 with provisions for designing GFRP reinforced concrete beams, one-way and two-way slabs, columns, walls, connections, and foundations. Other model codes and standards can directly reference ACI CODE 440.11-22 to allow for widespread, responsible use of this important technology. "This code is a significant milestone for our 440 committee and for the FRP community," says 440 committee Chair, Dr. Maria Lopez. "The hard work and efforts of many ACI Committee 440 members made development of this new Code possible, and it represents a tremendous accomplishment by the committee."

ACI Committee 440's mission is to disseminate information on the use of fiber reinforced polymer (FRP) materials and systems for reinforcing and strengthening concrete structures. Committee 440 has written and maintains a number of design guides, materials and construction specifications, reports and technical notes on the use of FRP in structural concrete applications.

To learn more about ACI and to get involved, visit concrete.org.

Recent Highlighted Publications

Design and Performance of a Tuned Vibration Absorber for a Full-Scale Lightweight FRP Pedestrian Structure

Author: Christian Gallegos-Calderón; Javier Naranjo-Pérez; Jaime H. García-Palacios; Iván M. Díaz.

DOI: 10.1061/(ASCE)CC.1943-5614.0001270

Journal: Journal of Composites for Construction

Abstract: Fiber-reinforced polymers (FRPs) have enabled the construction of lightweight footbridges, whose structural design is often governed by a serviceability limit state. A suitable approach to avoid overdimensioning an FRP footbridge may be to adopt a motion-based design strategy, where excessive human-induced vibrations are mitigated through the installation of tuned vibration absorbers (TVAs). In this sense, human–structure interaction (HSI) phenomena should be considered to estimate accurately the acceleration response of lightweight footbridges and size TVAs properly. Thus, this paper presents the design, installation, and performance assessment of a passive inertial controller for completing the construction of a full-scale FRP pedestrian structure. First, a general frequency-domain procedure to design TVAs for structures susceptible to HSI is proposed. The methodology considers a multiobjective optimization problem that minimizes simultaneously the structural response and the controller inertial mass. Second, the HSI load model of a bouncing pedestrian is identified experimentally to be used within the proposal to design TVAs. Third, a TVA of 25 kg is designed, assembled, and installed in the lightweight FRP structure, employing the proposed procedure. Then, the enhancement of the dynamic response due to the controller is assessed considering a person bouncing and two streams of walking pedestrians. For the different load scenarios, the TVA exhibits an adequate behavior to mitigate the vertical acceleration, demonstrating the feasibility to deliver an ultralightweight FRP footbridge with an inertial controller to meet requirements at different limit states.

Development of GFRP Monopole Guyed Communication Tower

Author: Sami Alshurafa; Hanan Alhayek; Dimos Polyzois.

DOI: 10.1061/JCCOF2.CCENG-3799

Journal: Journal of Composites for Construction

Abstract: In recent years, there has been a growing demand for a lightweight, dependable, and cost-effective construction material with low maintenance requirements and high corrosion resistance to replace steel communication towers. This paper reports on an examination of glass fiber–reinforced polymer (GFRP) as an unconventional material for the fabrication of a GFRP lightweight communication guyed tower. The study included extensive experimental testing as well as numerical modeling of a 9-m GFRP guyed communication tower. Extensive material testing was conducted to define the material properties required for modeling the guyed tower. Furthermore, the study involved the fabrication of a unique adjustable collapsible multiuse device to form the prismatic tower cells required for the tower's fabrication. The newly designed collapsible mandrel fabricated individual cells using fiberglass matting and a hand lay-up method. The 9-m tower had a uniform constant cross section of three identical cells bonded together to form an equilateral triangle with sides of 500 mm. The tower was tested under static loading conditions using a whiffle-tree arrangement to simulate uniformly distributed wind loading. Under static loading conditions, a comprehensive experimental strain and deflection study was conducted and three critical regions on the tower were thoroughly evaluated. To simulate the structural behavior of the tower, a nonlinear finite-element model was created. The results for the finite-element model were validated by comparing them with experimental results. The structural performance of the GFRP guyed tower was accurately predicted by the finite-element model.

A genetic evolved machine learning approach for 3D DEM modelling of anisotropic materials with full consideration of particulate interactions

Author: Zewen Gu; Xiaoxuan Ding; Xiaonan Hou; Jianqiao Ye.

DOI: 10.1016/j.compositesb.2022.110432

Journal: Composites Part B: Engineering

Abstract: Rapid development of multiscale modelling techniques has enabled significant improvement in understanding material failure. However, accurate simulation of general anisotropic materials still remains a great challenge. This is due to the unbalanced number of material parameters required by models of different scales, and it is difficult and sometime impossible to extract micro material properties from known macro properties. This paper proposes a new 3D discrete element model (DEM) to take full interactions between material particles for general anisotropic composite materials. The challenging issue in determining the micro bond properties of the 3 DEM model is resolved by coupling machine learning (ML) technique with the genetic algorithm (GA). The learned bond properties are validated by comparing DEM predicted macro material properties with experimental results. The micro bond properties are further used to predict strength and simulate crack patterns of bolted composite lap joints. The predictions of the ML model agree well with experimental results of the joints.

Pullwinding technique for realizing hybrid roving architecture in pultruded GFRP composites

Author: TianQiao Liu; Peng Feng; Juntian Tang; Xing Liu.

DOI: 10.1016/j.compstruct.2022.116483

Journal: Composite Structures

Abstract: In this work, pullwinding technique is adopted to realize the hybrid roving architecture in pultruded GFRP composites so as to improve their transverse properties as well as the flexural performance of GFRP beams. First, small-scale material characterization tests and large-scale four-point bending tests were conducted to evaluate the mechanical performance of pullwound composites and the flexural behavior of pullwound box-beams. Second, analytical study was performed to calculate the strength and modulus of laminated plates with hybrid roving architectures. Then, finite element modeling was conducted to assess the strength and stability limit states of pullwound beams. The hybrid roving architecture could effectively reduce the material orthotropy, thus improving the transverse properties of GFRP composites as well as the flexural performance of GFRP beams. In the end, a design procedure is proposed to facilitate the design of roving architecture of pullwound composites to achieve the desired mechanical properties.

Determination of vehicle loads on bridges by acoustic emission and an improved ensemble artificial neural network

Author: Laxman K C; Allen Ross; Li Ai; Alexander Henderson; Elhussien Elbatanouny; Mahmoud Bayat; Paul Ziehla.

DOI: 10.1016/j.conbuildmat.2022.129844

Journal: Construction and Building Materials

Abstract: Bridges are significant hubs in the U.S. national economy, facilitating the movement of goods and vehicles. The condition of bridges in the state of South Carolina is currently under scrutiny, especially in rural areas where most of the bridges were designed using outdated standards from the 1950 s. The weight of vehicles in recent years has increased significantly compared to the past. This has created an overloading problem. In addition, bridge performance decreases during their service life due to vehicle loads, material deterioration, and environmental erosion. Therefore, it is necessary to inspect and conduct load ratings on bridges to determine whether the bridges need to be posted. Due to recent advances in sensing technology and data analysis methods, nondestructive methods such as acoustic emission (AE) have been widely utilized in monitoring damage to the bridges. The objective of this paper is to explore the possibility of using AE sensors concurrently to determine vehicle loads on the bridges while monitoring bridge damage. A load determination method leveraging an improved ensemble artificial neural network (ANN) is proposed to analyze the AE data and estimate the load of the vehicle. The significance of this vehicle load determination method is that it has the potential to be paired with an AE damage monitoring system rather than using other instrumentation such as a weigh-in-motion (WIM) system. The proposed method has been tested on an experimental bridge component. The results suggest that the proposed model has an accuracy above 70 % in estimating the vehicle loads on the precast reinforced concrete (RC) flat slabs.

Fibers-induced segregated-like structure for polymer composites achieving excellent thermal conductivity and electromagnetic interference shielding efficiency

Author: Gui Yang; Mingjie Wang; Jingwen Dong; Fengmei Su; Youxin Ji; Chuntai Liu; Changyu Shen.

DOI: 10.1016/j.compositesb.2022.110253

Journal: Composites Part B: Engineering

Abstract: With the rapid development of new-generation wireless communication technologies and portable intelligent electronic devices, the development of composites with excellent thermal conductivity and electromagnetic shielding properties has become an urgent challenge. In this work, a unique fibers-induced segregated-like structure strategy for fabricating thermoplastic polyurethane/polydopamine/silver (TPU/PDA/Ag) composites film with high thermal conductivity (TC) and excellent electromagnetic interference (EMI) shielding performance is demonstrated via electrospinning-electroless depositing-pressing technology. The TPU/PDA/Ag composites film exhibit excellent in-plane TC of 20.9 W/(m·K) at 75 wt% Ag loading, which shows excellent thermal management capability as heat spreaders of high-power light-emitting diode (LED) modules in practice. Meanwhile, the composites film presents outstanding EMI shielding efficiency of 109 dB (8.2–12.4 GHz) with a thickness of 45 μm and prominent EMI shielding reliability after 1000 cycles of bending. In addition, the composites film shows good tensile strength (12.1 MPa), elongation at break (108.0%), and toughness (11.59 MJ/m3). The obtained TPU/PDA/Ag composites film achieves the desired balance among thermal conductivity, EMI shielding, and mechanical properties, indicating broad application prospects in new-generation wireless communication technologies and portable intelligent electronic devices.

ASCE Journal of Composites for Construction

The American Society of Civil Engineers (ASCE) Journal of Composites for Construction (JCC) is published with the support of IIFC. As a service to IIFC members and through an agreement with ASCE, *FRP International* provides an index of ASCE JCC. The ASCE JCC may be found at the following website:

http://ascelibrary.org/cco/

ASCE JCC subscribers and those with institutional access are able to obtain full text versions of all papers. Preview articles are also available at this site. Papers may be submitted to ASCE JCC through the following link:
http://www.editorialmanager.com/jrncceng/

Recent Issues

Volume 26, Issue 5. October 2022

An Experimental Study of the Behavior of GFRP-Reinforced Precast Concrete Culverts
Reza Hassanli, Osama Youssf, Alan Manalo, Mohammad Amir Najafgholipour, Mohamed Elchalakani, Enrique del Rey Castillo and Darren Lutze

Three-Dimensional Finite-Element Modeling of the Thermomechanical Response of GFRP-Reinforced Concrete Slab Strips Subjected to Fire
António P. C. Duarte, Inês C. Rosa, Mário R. T. Arruda, João P. Firmo and João R. Correia

Numerical and Analytical Study of Concrete Beams Reinforced with Hybrid Fiber-Reinforced Polymer and Steel Bars
Jiajing Xu, Peng Zhu and Wenjun Qu

Experimental and Analytical Study on Shear Performance of Embedded Through-Section GFRP-Strengthened RC Beams
Linh Van Hong Bui, Chanakan Klippathum, Tosporn Prasertsri, Pitcha Jongvivatsakul and Boonchai Stitmannaithum

The Effect of a Textile-Reinforced Mortar on the Flexural Response of Energy-Improved Infill Walls
André Furtado, António Arêde and Hugo Rodrigues

Ductile Concrete Columns Enabled by Multilayer Basalt TRM Shells: Confinement Mechanism and Modeling
Chenglin Wan, Jiyang Wang, Qiang Zeng, Xuchuan Lin and Lingxin Zhang

In-Plane Cyclic Performance of Masonry Walls Retrofitted with Flax Textile–Reinforced Mortar Overlays
N. Trochoutsou, M. Di Benedetti, K. Pilakoutas and M. Guadagnini

Revisiting the Net-Section Tensile Rupture Strength Limit State of Single-Bolt Connections in Pultruded Structures
Abdul-Hamid Zureick and Blaine Weinmann

Effect of Initial Static Loadings on Dynamic Shear Performance of BFRP-Reinforced Concrete Deep Beams
Yushuang Lei, Liu Jin, Fengjuan Chen, Wenxuan Yu and Xiuli Du

A Large-Tonnage High-Strength CFRP Cable-Anchor System: Experimental Investigation and FE Study
Jingyang Zhou, Xin Wang, Zhishen Wu and Zhongguo Zhu

Calibration of a Cyclic Cohesive-Zone Model for Fatigue-Crack Propagation in CFRP-Strengthened Steel Plates
Mana Mohajer, Massimiliano Bocciarelli and Pierluigi Colombi

Experimental Investigation of Concrete Beams Reinforced with Glass Fiber–Reinforced Polymer Bars
Timothy Tedford and Maria Anna Polak

Volume 26, Issue 6. December 2022

FRP INTERNATIONAL
the official newsletter of the International Institute for FRP in Construction

FRP International needs your input…

As IIFC grows, we seek to expand the utility and reach of *FRP International*. The newsletter will continue to report the activities of IIFC and focus on IIFC-sponsored conferences and meetings. Nevertheless, we also solicit short articles of all kinds: research or research-in-progress reports and letters, case studies, field applications, book reviews or anything that might interest the IIFC membership. Articles will generally run about 1000 words and be well-illustrated. Submissions may be sent directly to the editor. Additionally, please utilize *FRP International* as a forum to announce items of interest to the membership. Announcements of ***upcoming conferences***, ***innovative research or products*** and ***abstracts from newly-published PhD dissertations*** are particularly encouraged. All announcements are duplicated on the IIFC website (www.iifc.org) and all issues of the *FRP International* are also available in the archive at this site.

FRP International is yours, the IIFC membership's forum. The newsletter will only be as useful and interesting as you help to make