

## Third International Workshop on GFRP Bars for Concrete Structures

### **Workshop Theme: “Advances in concrete reinforcement”**

*In conjunction with the 8<sup>th</sup> International Conference on Advanced Composite Materials in Bridges and Structures (ACMBS-VIII) (5 – 7 August 2021)*

#### Organizers:

- **Chair:** **Brahim Benmokrane**, Professor of Civil Engineering and Tier-1 Canada Research Chair, and NSERC/Industry Research Chair, Director CRUSMAC, University of Sherbrooke, QC, CANADA
- **Co-Chair:** **Antonio Nanni**, Inaugural Senior Scholar Professor and Chair Dept. of Civil, Arch. & Environ. Engineering, University of Miami, FL, USA
- **Co-Chair:** **Steven Nolan**, Senior Structures Design Engineer, FDOT Structures Design Office, Tallahassee, FL, USA
- **Goal of Workshop:** *Defining a path to broadly implement FRP bar for safe, economical and resilient concrete structures. Non-corrosive FRP rebars are an effective alternative to steel-reinforced concrete, with a potentially broad market of applications. This workshop is geared for stakeholders involved in concrete construction, including owners, manufactures, installers, distributors, engineers, architects, and provinces, state, and city/local officials. The workshop aims to define a path to fully implement FRP bar for concrete structures.*

**Date: August 3-4<sup>th</sup>, 2021**

**Location:** VIRTUAL (The meeting link will be forward to participants)

### **\*\*\* AGENDA \*\*\***

#### **Monday, August 3<sup>rd</sup> - Education & Outreach**

**Welcome Remarks: 1:00 - 1:15 pm:** Introduction of topics and attendees

**Preamble:** Conduct a facilitated exercise, composed of asking questions around “*Challenges to rebar market entry*” that will result in an initial set of WORD CLOUDS. The idea is to collect attendee’s impressions visually of the FRP rebar industry and practice. These will be divided to develop questions related to the different areas of the workshop (Education, Outreach and Advancement).

#### **Session 1: Owner’s Perspective on the Use of FRP Bars (1:15 - 3:00 pm)**

Presentation 1-1 (2 @ 10 mins)

*Discussion 1-1 (30 mins)*

Presentation 1-2 (2 @ 10 mins)

*Discussion 1-2 (30 mins)*

*Topics of Interest:*

- a. Accelerated (Bridge) Construction advantages with FRP – Durability is not a concern; is coupling a challenge that needs solving?
- b. LCC/LCA for justification of FRP use
- c. What are the primary drivers for DOT's & other owners to fully implement FRP rebar?
- d. In projects where FRP is not specified, how would an owner make decisions about comparing these solutions with conventional materials (e.g., steel reinforcement)
- e. 'Toolkit' for owners when deciding to specify or select GFRP and/or BFRP over other non-corrosive reinforcements

*Break and Icebreaker – Poll Questions and compiling Chat Comments for Q&A*

**Session 2: FRP Bar Manufacturer's Installer's & Supplier's Perspective (3:20 - 5:20 pm)**

Presentation 2-1 (2 @ 10 mins)

*Discussion 2-1 (40 mins)*

Presentation 2-2 (2 @ 10 mins)

*Discussion 2-2 (40 mins)*

*Topics of Interest:*

- a. Distribution model for bent bars and custom lengths – manufacturer versus fabricator
- b. Uniform bar surface enhancement and bond properties
- c. Bar bend quality/appearance
- d. Methods of estimating for projects with FRP rebar (rule of thumb, inclusion in DOT cost estimate tables)
- e. Cost estimation – development of estimation tools

*Social Hour 5:30 – 6:30 pm (online, bring your own beverage and stories)*

**Tuesday, August 4<sup>th</sup> – Advancement of FRP-RC**

**8.00 – 8.15 am:** Lessons learned from day one and short summary. Review Visual Aids, add/generate new ones (10 mins)

**Session 3: Codes, Standards & Specifications Perspective on the use of FRP Bars (8:15 - 10:00 am)**

Presentation 3-1 (2 @ 10 mins)

*Discussion 2-1 (30 mins)*

Presentation 3-2 (2 @ 10 mins)

*Discussion 2-2 (30 mins)*

*Topics of Interest:*

- a. ASTM D7957 Specifications gaps:
  - Stiffness minimum value;
  - Mechanical durability: fatigue (bar and bond) and creep;
  - Chemical durability: strength, durability of bond;
  - Inclusion of other resins and fibers.
- b. UV degradation on-site (storage and phased construction) – is it really a problem?

- c. *'Toolkit' for DOTs/owners to adopt FRP-RC*
- d. *QC standardization by manufacturers:*
  - *What is critical to measure during production?*
  - *What internal QC tests are needed, is there a need to specify and standardize?*
  - *Lot testing turn-around time?*
  - *How to 'protect' industry from defective bars (both immediate properties as well as durability) can't tell apart?*

**Break**

**Session 4: Ongoing Research and New Applications (10:20 - 12:00 pm)**

Presentation 4-1 (2 @ 10 mins)

*Discussion 4-1 (30 mins)*

Presentation 4-2 (2 @ 10 mins)

*Discussion 4-2 (30 mins)*

*Topics of Interest:*

- a. *Resiliency of new structure designs considering functionality after major events.*
- b. *Bespoke Reinforcing*
- c. *Creep rupture and cyclic fatigue*
- d. *Connections/Coupling*
- e. *Concrete made from seawater/brine/contaminated aggregate: an opportunity for all stakeholders*
- f. *QC testing for manufacturers and laboratories*

**Closeout Session 5: Summary of Whitepaper (12:00 - 12:30 pm)**

Summary of Whitepaper\*\* from Sessions 1-4 (10 mins)

*Discussion and Vote of Confidence (15 mins)*

Closing Remarks (5 mins)

**\*\* Scribes will be present at each session discussion to record issues of concern, agreement and needs raised by attendees thru the Chat Box Q&A tools for advancing the safe and economical deployment of FRP reinforced concrete. These notes will be summarized at the conclusion for the preparation of a whitepaper. The whitepaper is expected to be completed by October 31<sup>st</sup> for distribution to the attendees as a record of the workshop and voluntary action plan preceding the **4<sup>rd</sup> International Workshop** in 2022/2023.**

**Sponsors:**

*University of Sherbrooke*

*University of Miami*

*Florida Department of Transportation*

*The University of Sherbrooke Research Centre on FRP Composite Materials for Structures (CRUSMaC)*

*Natural Science and Engineering Research Council (NSERC) of Canada*

*NSF I/U CRC Center for Integration of Composites into Infrastructure (CICI)*

**Topics for Project Case Studies on FRP-RC/PC Structural Applications**

1. Bridges - Superstructure
2. Bridges - Substructure
3. Concrete Pavement - CRCP
4. Buildings - Balconies
5. Buildings - Fire resistance
6. Magnetic sensitivity - Tolling & MRI structures, etc.
7. Stray current mitigation - Electrified rail & Utility structures.
8. Tunneling - Road, rail or transit
9. Tunneling - Water supply & wastewater
10. Retaining walls & Soil anchoring
11. Seawalls & Marine Structures

*1,000-word maximum paper length. Papers will be curated and provided to workshop participants in PDF format prior to the workshop.*

*The organizers also recommended developing a two-page Fast-Facts sheet as an Attachment or alternative for any project case-study. See the following website for the suggested format of the Project Fact-Facts sheet: <http://www.fdot.gov/structures/innovation/FRP.shtm#link9>*