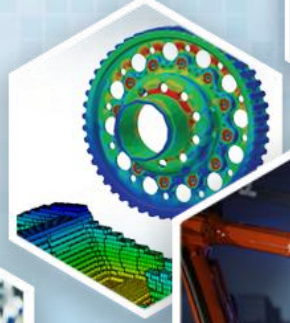
Infrastructure & Construction (I&C) Working Group Overview

Joe Fox, FX Consulting LLC
John Unser, Composite Applications Group

August 14, 2024



Topics for Today

- I&C-related R&D projects
- The Decarbonization message for FRP in I&C applications
- Funding for I&C activities
- Plans going forward

I&C-Related R&D Projects

Project Title	Status
FR Testing of Trimer Resin for I&C Applications	Completed
FRP for Off-shore Wind Floating Foundations	Ready to launch
Reuse of End-of-Life Wind Turbine Blades in I&C	In definition stage

Fire Resistance Testing of Trimer Resin for I&C Applications

- Project team = Trimer Technologies + Orenco
- FR testing conducted at UDRI and SWRI
  - E1354, E84, E119
- **Class A E84** rating
  - Surface Burning Characteristics
- **60-minute E119** rating
  - Wall panel test

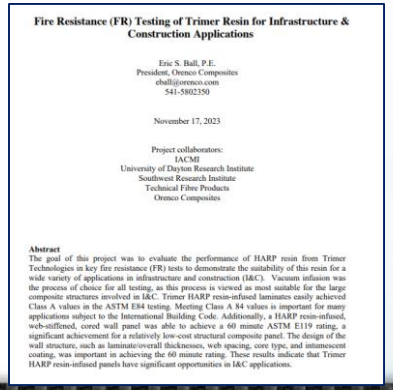
E84	✓
E119	✓

Steiner Tunnel used to run E84 test

Wall panel sample used in E119 test

Orenco/Trimer Project

- This project was featured in the IACMI booth at SAMPE ‘24 in Long Beach
- Finalist for a Combined Strength award at CAMX 2024
- You can access the final report on the IACMI website at:
  - https://iacmi.org/innovation/resource-pool-project-reports/
- For more information, contact
  - Resin: Henry Sodano, Trimer Technologies
    - hsodano@trimerllc.com
  - Fabricated elements: Eric Ball, Orenco
    - eball@orenco.com


Fire Resistance (FR) Testing of Trimer Resin for Infrastructure & Construction Applications

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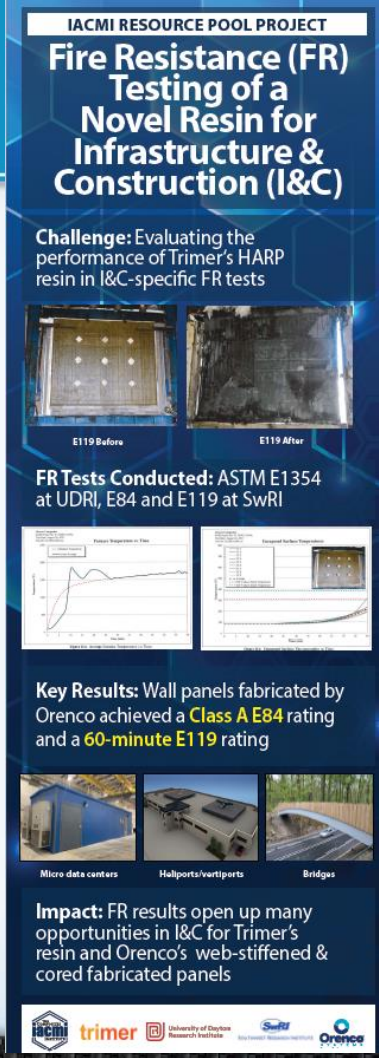
November 17, 2023

Project collaborators:
IACMI
University of Dayton Research Institute
Southwest Research Institute
Technical Fibre Products
Orenco Composites

Abstract

The goal of this project was to evaluate the performance of HARP resin from Trimer Technologies in key fire resistance (FR) tests to demonstrate the suitability of this resin for a wide variety of applications in infrastructure and construction (I&C). Vacuum infusion was the process of choice for all testing, as this process is viewed as most suitable for the large composite structures involved in I&C. Trimer HARP resin-infused laminates easily achieved Class A values in the ASTM E84 testing. Meeting Class A 84 values is important for many applications subject to the International Building Code. Additionally, a HARP resin-infused, web-stiffened, cored wall panel was able to achieve a 60 minute ASTM E119 rating, a significant achievement for a relatively low-cost structural composite panel. The design of the wall structure, such as laminate/overall thicknesses, web spacing, core type, and intumescent coating, was important in achieving the 60 minute rating. These results indicate that Trimer HARP resin-infused panels have significant opportunities in I&C applications.



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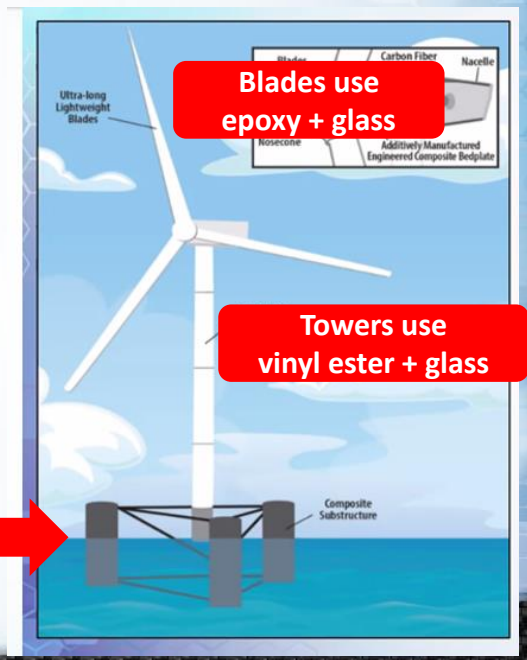
FRP Reinforcements for Off-Shore Wind Platforms

- U Maine has demonstrated the use of composites for blades and towers for off-shore wind
  - https://composites.umaine.edu/volturnus/

- Can GFRP rebar and/or CFRP strands be used in the floating foundations in place of steel?
  - Corrosion resistant
  - Lightweight



Can FRP also be used to reinforce the concrete in the floating foundations?

FRP Reinforcements for Off-Shore Wind Platforms

- IACMI Resource Pool project ready to launch
- Can you come up with a **cost-effective design** that will lower the amount of concrete required?
  - Lower cost
  - Lower CO_2 emissions
- This project could be a springboard to additional funding from DOE's Wind Energy Technology Office (WETO)
  - Scale-up
  - Prototypes
  - Testing

IACMI Resource Pool Funding Request

Date: April 19, 2024

Project Title: Hybrid Concrete-Composite Floating Offshore Wi… …ndations

Preliminary Design and Cost Assessment for the Use of Composite Reinforcements in Place of Traditio… Steel Rebar and Post-tensi… Tendons for Concrete Floati… Turbine Foundations to … Increase Durability, … Carbon Footprint.

Approved

Project Partner Lead Organiza…

THE UNIVERS… MAINE

University of Maine Advanced Structures and Composites Center

POC Name: Dr. Anthony Viselli, PE, Chief Engineer and Assistant Director

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Motivation

- Ten of thousands of blades are scheduled to be decommissioned
- I&C represents an outlet for significant amounts of recycled material from blades
- Recycling of blades is a priority area in IACMI's proposal to the DOE for IACMI 2.0

To address these challenges IACMI proposes solution pathways and metrics that will include:

- Developing a circular economy for wind turbine blades which includes blade recycling, material reuse, and sustainable materials development to significantly increase recycling and reuse of materials from both traditional thermoset blades as well as recyclable-by-design blades. Emphasis will be on thermoplastics, reversible thermosets, vitrimers, and bio-based resin systems as well as separation and recycling technology, supply chain and logistics, re-use and re-purposing, and life cycle analysis (LCA).

- Opportunity for 3 working groups to work together
  - Wind Energy + Recycling/Circular Economy + I&C
- IACMI 2.0 funding is now available

Exploring Potential Solutions

- Steve Nolet from TPI has explored numerous potential solutions for end-of-life blades
  - No **formal** IACMI project

- It's time for a formal **"Blades to Buildings"** project

Creating a "Blades to Buildings" IACMI 2.0 Project

Reuse of End-of-Life Wind Turbine Blades in I&C

REC RiversEdge Composites

Building panels

TEXTECH INDUSTRIES

Carbon Rivers

EnviroLiner

Cured-in-Place Pipe

(How) Can we move one or more of these recycling technologies to a higher TRL?

GreenTex Solutions, LLC

Flooring

RISE BUILDING PRODUCTS

Trim & Siding

“Palooza” Summary

- Palooza = Joint working group session held yesterday
- 3 working groups participated
  - Wind Energy, Recycling/Circular Economy, I&C
- Panel
  - Kevin Line — Rise Building Products
  - David Morgan — Carbon Rivers
  - Neil Rohan — RiversEdge
  - John Unser — GreenTex Solutions
- **Next step:** Use the output from the Palooza to define a “Blades to Buildings” project(s)
  - Common needs
  - Specific needs

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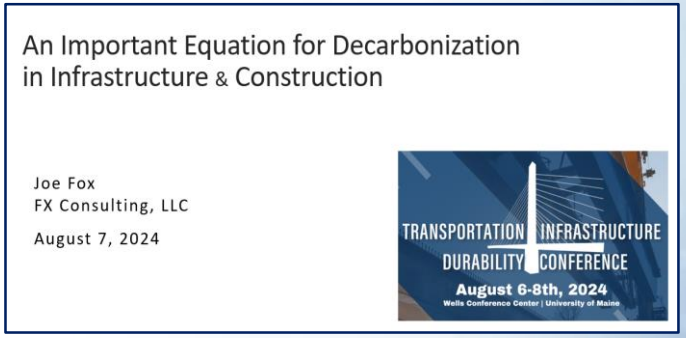
Decarbonization with FRP Composites

- Decarbonization is another “hot topic”
- The working group has a subcommittee focused on Decarbonization with FRP
  - Developing a decarbonization message
  - Spreading the word to the I&C community

Southeastern DOTs

Army Corps of Engineers



New England DOTs

The Decarbonization Message for FRP

The use of FRP composites
can lower Embodied Carbon and CO_2 emissions
in Infrastructure & Construction applications

When they are used
in place of steel

When they are used
in conjunction with concrete

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	% Reduction in GHG Emissions Possible with FRP vs Steel		
	Achievable (Low)	Typical (Median)	Baseline (High)
Rebar	8	25	57
Girders	21	46	74
Gratings	37	60	70

Double-digit reductions in GHG emissions

The Decarbonization Message for FRP

The use of FRP composites
can lower Embodied Carbon and CO_2 emissions
in Infrastructure & Construction applications

Example	% Reduction in CO_2 Emissions
Halls River Bridge	26
CarbonCast with C-GRID	~ 40%
Hillman Composite Beam	42
Carbon Prestressed Concrete	Up to 75%

When they are used
in conjunction with concrete

Double-digit reductions in GHG emissions

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Funding from the EPA to Lower Greenhouse Gas Emissions

- In July, the EPA selected IACMI & ACMA to receive a **$6M** award to help composite fabricators create Environmental Product Disclosures (EPDs) and Life Cycle Assessments (LCAs)

Grant Program: Reducing Embodied Greenhouse Gas Emissions for Construction Materials and Products

EPA

- ACMA & IACMI's CIRCLE partnership is intended to show how emissions of CO_2 & other greenhouse gases can be lowered with composites

- CIRCLE leverages IACMI's expertise in contracting and program management

https://terrapinblue.box.com/s/c7t466qpe74qqln1vk07blvwy5gtqee0

IACMI & ACMA's CIRCLE Partnership

- CIRCLE would involve:
  - Program operators who are skilled in the creation of LCIs, LCAs, PCRs, EPDs…
  - Manufacturers of composite products who want to create **Cradle-to-Gate** EPDs for their products
  - Universities & community colleges to collect & generate **Gate-to-Grave** data
    - Construction, Use, End-of-Life stages
  - End users/decision makers who want to see EPDs
    - State DOTs, the Army Corps of Engineers, building designers…..

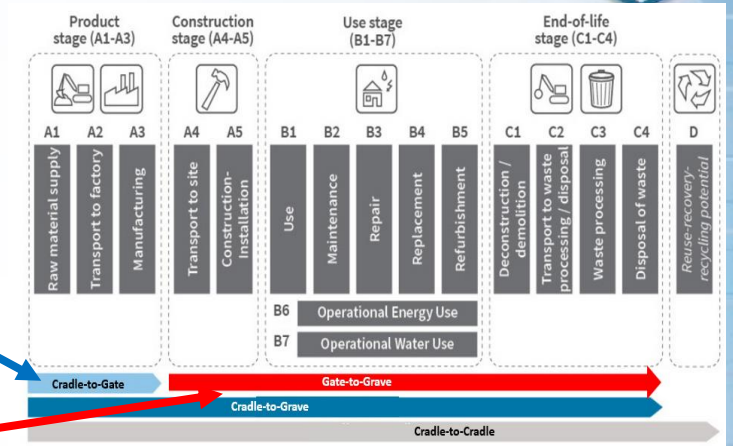

Figure 1. Life cycle stages of building materials in LCA. *Carbon Leadership Forum 2023*

The DOT's Low Carbon Transportation Materials Grant Program

What is the Low Carbon Transportation Materia (LCTM) grant program?

FHWA webinar 4/28/24

- Established by Section 60506 of the Inflation Reduction Act (IRA) and codified in Section 179 of 23 U.S.C.
- $2B grant program for eligible projects that include materials and products determined to have "substantially lower levels of embodied greenhouse gas emissions," as described by the Environmental Protection Agency (EPA)
- Provides either a reimbursement (equal to the incrementally higher cost) or incentive (2% of the cost of the eligible material or product)

Inflation Reduction Act Section 60506
Low-Carbon Transportation Materials Program
Request for Applications

Program Details	
Available Funds	$1.2 billion
Anticipated Award	At least $22 million per State department of transportation submitting responsive application
Request for Application Period Opens	March 12, 2024
Request for Application Period Closes	11:59 p.m. EST on June 10, 2024
Questions	Can be submitted to: FHWALowCarbonMaterials@dot.gov

$1.2B available now to state DOTs

Why ACMA & IACMI's CIRCLE Partnership is Important

- FRP is **not** included in the list of eligible materials for Low Carbon Transportation Materials grants to state DOTs

The composites industry needs LCAs and EPDs to compete!

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Plans Going Forward

- Launch the FRP for off-shore wind floating foundations project
- Define & launch the “Blades to Buildings” project(s)
- Continue to strengthen & communicate the Decarbonization message for FRP
- Begin to execute the game plan for the EPA grant
  - Work with ACMA to:
    - Identify companies that need EPDs
    - Identify universities that can conduct Gate-to-Grave LCAs and predict the estimated service life

Opting into the I&C Working Group

- If you would like to “opt in” to the I&C working group, send an e-mail to these 3 people:
  - Kim Hoodin khoodin@iacmi.org
  - John Unser john@compositeapplicationsgroup.com
  - Joe Fox foxconsulting147@gmail.com

Thank you!