FDOT GFRP-RC Implementation - Current Status, Projects and Challenges

Prepared by:

Sam Fallaha¹, Chase Knight² & Steven Nolan¹

¹ FDOT State Structures Design Office
² FDOT State Materials Office
Current Status, Projects and Challenges

Part 1:
• The Need – Why Composites?
• Available Documentation
• FDOT Research
• Projects
• Looking Forward

Part 2:
• Challenges
• Focus Areas
The Need – Why Composites?
The Need – Why Composites?

- Avoiding Corrosion
- Durability/Service Life
- Cost/Benefit Analysis
- Mitigating Risks

Old St. George Island Bridge Piling

Gandy Blvd. seawall, (Tampa Bay)

New and Old Seven Mile Bridge, (Florida Keys)

Courtney Campbell Causeway, seawall (Tampa Bay)
The Need – Why Composites?

- Avoiding Corrosion
  - Durability/Service Life
  - Cost/Benefit Analysis
  - Mitigating Risks
The Need – Why Composites?

- Example Costs of Corrosion
  - FDOT District 7 Study
    - Repair cost of bridges
    - 54 Bridge Projects Studied (02/03 to 12/13)
      - 20 Steel and 34 Concrete Bridges

Source: FDOT D7 District Structures Maintenance Office & T.Y. Lin
Available Documentation

Design Documentation

What’s available from FDOT?
1. Design criteria –
   a) Fiber Reinforced Polymer Guidelines (FRPG)
   b) Structures Design Guidelines (SDG);
2. Detailing criteria – Structures Detailing Manual (SDM);
3. Design Standards (drawings);
Available Documentation

Design Documentation

1. Design criteria –
   a) Fiber Reinforced Polymer Guidelines (FRPG)
      • Overall commentary on FRP;
      • Specific design criteria, plan content and Specification requirements;
      • Design review requirements;
      • Approval of use process;
      • Permitted uses for each type of FRP.

   b) Structures Design Guidelines (SDG)
      • Overall design criteria;
      • Revised and/or supplemented by Fiber Reinforced Polymer Guidelines (FRPG) for given applications of FRP.

Available Documentation

Design Documentation

2. Detailing criteria – *Structures Detailing Manual (SDM)*:
   a) Overall detailing criteria;
   b) Revised and/or supplemented by *Fiber Reinforced Polymer Guidelines (FRPG)* for given applications of FRP.
Available Documentation

Design Documentation

3. **Design Standards:**
   a) FY2017-18 Design Standards:
      • *Index 22600 series* – Square CFRP & SS Prestressed Concrete Piles;
      • *Index 22440* – Precast Concrete CFRP/GFRP & HSSS/GFRP Sheet Pile Wall

   b) Developmental Design Standards:
      • *Index D6011c* – Gravity Wall – Option C (GFRP reinforced);
      • *Index D21310* – Pultruded FRP Bar Bending Details;
      • *Index D22420* – GFRP reinforced 32” F-Shape Traffic Railing;
      • *Index D22900* – GFRP reinforced Approach Slab;

http://www.fdot.gov/roadway/DesignStandards/Standards.shtm

http://www.fdot.gov/roadway/DS/Dev.shtm
Available Documentation

Design Documentation

4. **Construction & Material Specifications**
   a) Standard Specifications (effective July 2016+):
   - Implemented previous FRP *Developmental Specifications*.
   - **400** Concrete (includes FRP Bar construction considerations);
   - **415** Reinforcing for Concrete (FRP Bars construction considerations);
   - **450** Precast Prestressed Concrete Construction (FRP Bars construction considerations);
   - **932** Nonmetallic Accessory Materials for Concrete Pavement and Concrete Structures (GFRP & CFRP Bars material specs);
   - **933** Prestressing Strand (CFRP Strand material specs);


   (Photograph) Hughes Bros. Coated tie wire.
Available Documentation

Material & Producer Requirements

State Materials Office Oversight Role:

- **Material Specifications**
- **Sampling and Testing Requirements**
- **Quality Control Program – Production Facility Approvals**
- **Conduct and Facilitate Research – Durability/Service Life**
Available Documentation

Material & Producer Requirements

1. Producer Quality Control
   a) Specifications Section 105
   b) Materials Manual Chapter 12.1
   c) Specifications Section 932 & 933

2. Acceptance at the Project Level
   a) Certification
   b) Sampling and Testing

3. Materials Acceptance and Certification System (MAC)
Available Documentation

Material & Producer Requirements

1. Producer Quality Control
   a) Section 105 – Contractor Quality Control
      • FRP producers must meet requirements of Materials Manual
   b) Materials Manual Chapter 12.1
   c) Specifications Section 932

2. Acceptance at the Project Level
   a) Certification
   b) Sampling and Testing

3. MAC

http://www.dot.state.fl.us/programmanagement/Implemented/SpecBooks/default.shtm

http://www.dot.state.fl.us/programmanagement/Implemented/SpecBooks/Section12V2.shtm
Available Documentation

Material & Producer Requirements

1. Producer Quality Control
   a) Specifications Section 105
   b) Materials Manual Chapter 12.1
      • Production Facility Qualification Process
      • Producer Responsibilities
      • Incoming raw material control
      • Manufacturing quality control
      • QC inspection
      • Handling, Storage, Shipment
      • Documentation and Record Retention
   c) Specifications Section 932

2. Acceptance at the Project Level
   a) Certification
   b) Sampling and Testing

http://www.fdot.gov/programmanagement/implemented/URLinSpecs/Section121V2.shtml
Available Documentation

Material Requirements

1. Producer Quality Control
   a) Specifications Section 105
   b) Materials Manual Chapter 12.1
   c) Specifications Section 932
      • Since July 2016
      • Sizes and Strengths
      • Physical Property Requirements for Producer Qualification
      • Requirements for Acceptance at the Project Level

2. Acceptance at the Project Level
   a) Certification
   b) Sampling and Testing

3. MAC

http://www.fdot.gov/programmanagement/Implemented/SpecBooks/default.shtm
Available Documentation

Material Requirements

1. Producer Quality Control
   a) Specifications Section 105
   b) Materials Manual Chapter 12.1
   c) Specifications Section 932

2. Acceptance at the Project Level
   a) Certification
      • Notarized Statement from FRP Producer sent \textbf{prior to shipment}
      • Certificate of Analysis for each LOT sent with each shipment
   b) Sampling and Testing

3. MAC

\textit{2017 International Workshop on GFRP Bar for Concrete Structures}
Available Documentation

Material Requirements

1. Producer Quality Control
   a) Specifications Section 105
   b) Materials Manual Chapter 12.1
   c) Specifications Section 932

2. Acceptance at the Project Level
   a) Certification
   b) Sampling and Testing
      • Samples selected by Engineer after delivery to project
      • Contractor responsible for verification testing using independent ISO Lab

3. MAC
Available Documentation

Material Requirements

1. Producer Quality Control
   a) Specifications Section 105
   b) Materials Manual Chapter 12
   c) Specifications Section 932

2. Acceptance at the Project Level
   a) Certification
   b) Sampling and Testing

3. MAC
   a) Specifications
   b) Production Facility Profiles and Listings

https://mac.fdot.gov/smoreports

2017 International Workshop on GFRP Bar for Concrete Structures
Available Documentation

Material and Producer Requirements

1. Producer Quality Control
   a) Specification Section 105
   b) Materials Manual Ch. 12.1
   c) Specifications Section 932, 933, and 973

2. Acceptance at the Project Level
   a) Certification
   b) Sampling and Testing

3. MAC
   a) Specifications
   b) Production Facility Profiles and Listings
Current Research

Projects


• **BDV34-977-05**: “Degradation Mechanisms and Service Life Estimation of FRP Concrete Reinforcements” ([https://rip.trb.org/view/2015/P/1352376](https://rip.trb.org/view/2015/P/1352376)), Est. Completion: 3/31/2018

• **BDV30-706-01**: “Inspection and Monitoring of Fabrication and Construction for the West Halls River Road Bridge Replacement” (Sample testing and 2 year post-construction monitoring; Est. Completion 11/31/2019)
### Past Research – CFRP Prestressed Concrete Piles

http://www.fdot.gov/structures/structuresresearchcenter/CompletedResearch.shtm

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Authors</th>
<th>University</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/16/2014</td>
<td>Investigation of Carbon Fiber Composite Cables (CFCC) in Prestressed Concrete Piles</td>
<td>M. Roddenberry, P. Mtenga</td>
<td>Florida State University</td>
<td>BDK83 977-17</td>
</tr>
<tr>
<td>11/30/1998</td>
<td>Studies on Carbon FRP (CFRP) Prestressed Concrete Bridge Columns and Piles in Marine Environment</td>
<td>M Arockiasamy</td>
<td>Florida Atlantic University</td>
<td>B-9076</td>
</tr>
<tr>
<td>8/1/1995</td>
<td>Durability of CFRP Pretensioned Piles in Marine Environment Volume II</td>
<td>R. Sen</td>
<td>University of South Florida</td>
<td>0510642</td>
</tr>
</tbody>
</table>
1. **Cedar Key Bulkhead Cap Rehab.**
   - FPID 432194-1 construction completed June 2016; SMO monitoring.

2. **Halls River Bridge Replacement**
   - Construction started 1/9/2017;
   - Astaldi Construction Corp.

3. **Bakers Haulover Cut Bridge Rehab.**
   - Construction started 1/9/2017;
   - Kiewit Infrastructure South Co.

4. **Skyway South Rest Area Seawall Rehab.**
   - Design Build Procurement;
   - Awarded 2/10/2017;
Project Example 1 – Cedar Key SR24 Bulkhead Rehabilitation

FPID# 432194-1
Project Example 1 – **Cedar Key SR24 Bulkhead Rehabilitation**

3 bar-surface types:
- a) Ribbed
- b) Sand-coated
- c) Helically wrapped and sand-coated

Temporary UV protective for bulkhead cap reinforcing.
Project Example 2 – Halls River Bridge Replacement Project

**Designer:** FDOT District 7 Structures Design Office

**Structures EOR:** Mamunur Siddiqui, P.E.

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**Owner & Maintaining Agency**

**Design & Bi-Annual Inspection**

**Funding & Monitoring**

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**2017 International Workshop on GFRP Bar for Concrete Structures**
Project Example 2 – Halls River Bridge Replacement Project

Proposed Bridge Section

COMPLETED STRUCTURE

CFRP/GFRP Sheet Pile Walls
Project Example 3 – Bakers Haulover Cut Bridge Bulkhead Replacement

FPID# 433378-1
Project Example 4 – *Skyway South Rest Area Seawall Rehabilitation*  
FPID# 437973-1 & 43852-1

**Design-Build Contractor:** *David Nelson Construction Co.*

**Example RFP language:**

- **FPID 437973-1, South Rest Area Site:**
  - The existing seawall and handrail shall be raised.
  - Extend the seawall southward 285’ from the end.
  - Fill behind the seawall to provide for a grassed area and grade for drainage.
  - Metallic reinforcement is not allowed.
  - Non-metallic Reinforcement must meet design criteria and specification

- **FPID 438528-1, Seawall:**
  - Remove and replace the existing seawall cap.
  - Metallic reinforcement is not allowed.

*Source: Request for Proposal (Revised August, 2016)*
Project Example 4 – *Skyway South Rest Area Seawall Rehabilitation*

- Cracking of existing seawall bulkhead cap
- Limits of seawall bulkhead cap replacement
- Limits of seawall bulkhead cap replacement near Rest Area
Looking Forward

Promote the Use of FRP – Use it where you need it

FDOT Transportation Innovation Challenge

Structures Design Office

Curved Precast Spliced U-Girder Bridges
Fiber Reinforced Polymer Reinforcing
Geosynthetic Reinforced Soil Integrated Bridge System
Geosynthetic Reinforced Soil Wall
Prefabricated Bridge Elements and Systems
Segmental Block Walls

http://www.fdot.gov/structures/innovation/FRP.shtml

Technology Transfer (T²)

The following links to FDOT meetings, seminars and workshops are provided as background information for potential users and industry partners:

- FDOT/FHWA Corrosion-Resistant Rebar (CRRB) Seminar (July 17, 2012)
- FHWA/NCHRP 20-68A U.S. Domestic Scan 13-03 meeting with FDOT (June 4-5, 2015)
- FDOT-FRP Rebar Industry Workshop (June 15, 2015)
- Composites-Halls River Bridge Promotional Video for CAMX 2016 (September 28-29, 2016)
- CAMX 2016: FDOT-FRP Deployment for Structural Applications (for new construction) (September 29, 2016)
- ACMA-Transportation Structures Council (TSC) Meeting - FDOT Presentation (Sept. 29, 2016)
- FDOT/FTBA Construction Conference - FRP Presentation Schedule Pending (Feb. 2-3, 2017)
- Halls River Bridge Replacement FRP Demonstration Project Workshop (May 3, 2017)
Challenges & Focus Areas

See to Part 2 – Do we need a Roadmap for further deployment?

• Challenges to expanded FRP Implementation;
• FDOT Priorities
• Potential Focus Areas;
Priority Focus Areas:

1. Increase the variability in bent shapes. The goal would be to duplicate every shape on the FDOT *Design Standard* Index 21300;
2. Methods/tests to determine expected life of the products in place, durability modeling and predictions;
3. Maintenance inspection of rebar embedded in concrete;
4. Repair of damaged FRP rebar during construction and when discovered during maintenance inspections;
5. Updating of all design factors (FDOT will approach NCHRP with a recommendation to pursue this as a parallel effort);
6. Continue to coordinate with AASHTO and ACMA-TSC to develop design codes and test protocols (FDOT will continue to participate in all related AASHTO activities);
Questions?

FDOT Contact Information:

**Structures Design Office:**
Sam Fallaha, P.E. (Assistant State Structures Design Engineer)
(850) 414-4296
Sam.Fallaha@dot.state.fl.us

Steven Nolan, P.E. (Structures Standards Coordinator)
(850) 414-4272
Steven.Nolan@dot.state.fl.us

**State Materials Office:**
Chase C. Knight, PhD. (FRP Coordinator)
(352) 955-6642
Chase.Knight@dot.state.fl.us

Ivan Lasa, B.S.C.E. (Corrosion Lab.)
(352) 955-2901
Ivan.Lasa@dot.state.fl.us

*2017 International Workshop on GFRP Bar for Concrete Structures*
Part 2
Do we need a Roadmap?

- Challenges to expanded FRP Implementation
- FDOT Priority Focus Areas
- Potential Focus Areas
Roadmap

Challenges to expanded FRP Implementation:

1. Material Cost
   - First cost should include benefits of reduced cover, reduction of concrete additives for durability, and labor/installation savings due to lightweight.
   - Life-Cycle Cost Analysis should be utilized.
   - SEACON is generating LCC/LCA data that may be helpful.
   - Consider developing example cost comparisons
Roadmap

Challenges to expanded FRP Implementation (cont.):

2. Lack of confidence in durability for submerged environments (FDOT seeking 75 - 100 year service life)
   - Accelerated testing could address this issue. OC could update previous tests using samples subjected to sustained load+saltwater+60°C (may need to consider alkalinity also)? The outcome could be a new set of creep-rupture curves that account for environmental effects.
     - FDOT doing some accelerated testing investigation under BDV30-977-15 “Performance evaluation of glass fiber reinforced polymer (GFRP) reinforcing bars embedded in concrete under aggressive environments” (FSU-UM)
   - Look at quality of bends compared to straight bars for these conditions.
     - FDOT proposed SMO research was not advanced last year.
Roadmap

Challenges to expanded FRP Implementation:

3. Limitations on the strength due to degradation of properties over time (currently $C_E$ factor = 0.7 for GFRP exterior environments) [goes with Challenge #2]

- Use tests on field-retrieved bars and correlate to accelerate-conditioning tests to develop reliable knockdown factors for 100 years of service life (See Ali & Benmokrane, Recommended Value for the Environmental Reduction Factor ($C_E$) for GFRP Bars in ACI 440-H XXX Code, for $C_E = 0.9$, for 100 year service life GFRP with VE resin, July 2017);

- Existing sustained stress limit is 0.20 of guaranteed times $C_E$ to account for creep-rupture and fatigue under service loads. Is the creep-rupture limit actually affected by long-term environmental exposure?

- Current FDOT research project: BDV34 977-05 “Degradation Mechanism and Service Life Estimation of FRP Concrete Reinforcements”, may provide some answers.
Challenges to expanded FRP Implementation:

4. Limitations on strength due to low design resistance factors (\(\phi\) factors) related to lack of ductility and strength variability in the FRP materials (currently 0.55-0.65 for tensioned-control to compression-controlled flexural failure modes)

- This is a design issue that could be tackled immediately based on reliability.
- For flexure, revisit existing data and verify proposal by Jawaheri and Nanni (see Table 9).

Table 9—Recommended strength reduction factors for FRP reinforced beams

<table>
<thead>
<tr>
<th>Limit state</th>
<th>Strength reduction factor ((\phi))</th>
</tr>
</thead>
<tbody>
<tr>
<td>FRP rupture*</td>
<td>0.70</td>
</tr>
<tr>
<td>Concrete crushing*</td>
<td>0.75</td>
</tr>
<tr>
<td>Shear†</td>
<td>0.75</td>
</tr>
</tbody>
</table>

*Conservatively: \(\phi=0.70\) for both modes; †Shear reinforcement limit is modified as \(V_f \leq 3V_c\).
4. Limitations on strength... (continued)

Code comparison prepared by SSDO:

<table>
<thead>
<tr>
<th>Action</th>
<th>Failure Mode</th>
<th>Phi (AASHTO)</th>
<th>Phi (ACI)</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conventional Steel Reinforcing:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shear</td>
<td>Brittle</td>
<td>0.75</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Flexure-CC</td>
<td>Brittle</td>
<td>0.75</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Flexure-TC</td>
<td>Ductile</td>
<td>0.90 (1.00)</td>
<td>0.90</td>
<td>() = prestressed</td>
</tr>
<tr>
<td><strong>FRP Reinforcing:</strong></td>
<td></td>
<td>(AASHTO-GS)</td>
<td>(ACI -440)</td>
<td></td>
</tr>
<tr>
<td>Shear</td>
<td>Brittle</td>
<td>0.75</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Flexure-CC</td>
<td>Brittle</td>
<td>0.65</td>
<td>0.65</td>
<td>non-prestressed</td>
</tr>
<tr>
<td>Flexure-TC</td>
<td>Brittle</td>
<td>0.55</td>
<td>0.55</td>
<td>non-prestressed</td>
</tr>
<tr>
<td>Flexure-CC</td>
<td>Brittle</td>
<td>N/A</td>
<td>0.65</td>
<td>CFRP-prestressed</td>
</tr>
<tr>
<td>Flexure-TC</td>
<td>Brittle</td>
<td>N/A</td>
<td>0.85</td>
<td>CFRP-prestressed</td>
</tr>
</tbody>
</table>

- Prestress resistance factors might be reduced for TC = 0.75 & increased for CC = 0.80 based on new reliability study by Kim & Nickle (*ACISJ Tile 113-S89, Sept-Oct 2016*)
- Could also consider eliminating minimum flexural reinforcing limits when excesses Mcr capacity is provided (maybe 1.5Mcr ??).
Roadmap

Challenges to expanded FRP Implementation:

5. Limitations on the service limit states due to creep-rupture:
   - Existing sustained stress limit is 0.20 of guaranteed strength times $C_E$ to account for fatigue and creep-rupture under service loads.
     - *Is 0.20 $f_u$ too low?*
   - Same 0.20 limit for both fatigue (range) and creep (sustained).
     - *New ACI 440.1R-15 under 7.4.2 implies that sustained+range $\leq 0.2 f_u$, is this valid? If so why even check creep at 0.2$fu$?*
     - *Is the AASHTO-Fatigue I load case (1.5 x design truck – for infinite life) consistent with the intention under ACI 440.1R for fatigue?*
     - *AASHTO-GS 2.7.3 creep-rupture limit loading is unclear (should this be just Dead Load at Service I, since what portion of the Live Load would be considered sustained load?)*
   - Need endurance testing based on modern bar properties.
Challenges to expanded FRP Implementation:

6. **Low Elastic Modulus, resulting in greater deflections and larger crack openings**
   - Not likely we can increase MoE significantly, so...
   - Revisit default $k_b$ factor = 1.4, for crack width estimation, or require testing in Spec 932 to establish a lower value for design (maybe 1.0).
   - Consider combining with FRC to control crack size openings. Would need tools to quantify effect of FRC on crack width (0.02” max.) and deflections.

7. **Shear design:**
   - Shear provisions could be reconciled with Canadian standards method which is much less conservative.
Challenges to expanded FRP Implementation:

8. Restrictions in bar bending capabilities, and challenges with field modifications to bar shapes
   - Manufacturers could propose standardized shape of higher quality revisiting minimum radius of curvature and 60% efficiency.
     - For design, clarify how the 40% strength reduction is applied for bent shear stirrups?
   - Continuous close stirrups/ties are now possible and allow tight corners, and do not rely on GFRP-concrete bond.
     - Would test methods differ for these types of stirrups?
     - What is the maximum leg length before surface bonding would be required?
   - Consider combining GFRP stirrups/ties with carbon or steel strand in PC applications.
     - Would need to quantify confinement effect.
Roadmap

Challenges to expanded FRP Implementation:

   • This work is underway

10. Maintenance Inspection Methods
11. Repair Methods
SDO (RR’s) priorities (2/28/2017)

Priority Focus Areas:

1. Increase the variability in bent shapes. The goal would be to duplicate every shape on the FDOT standard index *(Challenge #8)*
2. Methods/tests to determine expected life of the products in place, durability modeling and predictions *(Challenge #2 & 5)*
3. Maintenance inspection of rebar embedded in concrete *(Challenge #10)*
4. Repair of damaged FRP rebar during construction and when discovered during maintenance inspections *(Challenge #11)*
5. Updating of all design factors (FDOT will approach NCHRP with a recommendation to pursue this as a parallel effort) *(Challenge #2, 3, 4, 5, 6, 7 & 9)*
6. Continue to coordinate with AASHTO and ACMA-TSC to develop design codes and test protocols (FDOT will continue to participate in all related AASHTO activities) *(Challenge #9+)*
Roadmap

Expanded list of Potential Focus Areas:

1. **(Challenge# 2)** Resolution of durability question especially in submerged environments;
   - SMO projects. (Do we need other testing?)
     1. BDV34-977-05 Degradation Mechanisms and Service Life Estimation of FRP Concrete Reinforcements, A. El-Safty (UNF), due 3/31/2018
     2. BDV30-977-18 Performance Evaluation of GFRP Reinforcing Bars Embedded in Concrete Under Aggressive Environments, R Kampmann (FSU), Due 5/31/2018
2. **(Challenge# 3)** Refinement of Environmental Reduction factors (CE);
3. **(Challenge# 4)** Rationalization of Resistance Factors ($\phi$ factors) used to address lack of ductility and variability in material strength properties;
4. **(Challenge# 5)** Endurance limits – refine fatigue and creep-rupture design limits and loading;
5. **(Challenge# 6)** Mitigation of lower elastic modulus effects as related to member deflections and concrete crack widths;
6. **(Challenge# 8)** Advancement in bent bar fabrication;
Roadmap

Expanded list of Potential Focus Areas (cont.):

7. **(Challenge# 9) Improved FRP Industry coordination** especially between ACMA-TSC and AASHTO SCOBS-T6 (FRP) & T10 (Concrete);

8. **(Challenge# 10) Maintenance Inspection/Test methods**
   i. Maintenance inspection of rebar embedded in concrete;
   ii. Non-Destructive Test Methods for identifying deterioration preferable.

9. **(Challenge# 11) Repair Methods**
   i. Repair of damaged FRP rebar during construction and when discovered during maintenance inspections

10. **Investigate hybrid designs** – using GFRP stirrups/rebar with Carbon or Steel prestressing strands;
Roadmap

Expanded list of Potential Focus Areas (cont.):

11. Continued Standardization through:
   i. Design Specifications
      • AASHTO Guide Spec update (T5) → LRFD Chapter 5 inclusion (T10);
      • ACI 318-GFRP design companion document/address column design;
   ii. Material Specifications
      • FDOT Specification Sections 932 & 933;
      • ACI 440-K/ASTM D30.10: new Specification for Solid Round Glass Fiber Reinforced Polymer Bars for Concrete Reinforcement, WK43339;
   iii. Pre-Fabrication
      • Cages (ACP, Sheet Piles, Traffic Railings, Precast Caps)
      • Closed stirrups
      • 2D-Grids/Mats (e.g. Decks and Noise Wall Panels);
      • Closed Stirrups/Hoops;
      • Headed Anchors;
   iv. Pre-designed of Structural Elements (such as FDOT Design Standards Indexes);
Roadmap

Expanded list of Potential Focus Areas (cont.):

13. Guidance on the use of Life Cycle Cost Analysis for FRP justification:
   i. Coordinate with SEACON-WP6;
   ii. Utilize FHWA/& NCHRP Report 483;
   iii. Consider Leveraging Sustainability angle if permitted:
      • From 2016 National Bridge Conference: Jianwei Huang and Chris Strazar, “Sustainability of GFRP RC Bridge Deck: Materials Cost”, Southern Illinois University Edwardsville: This research clarifies the concern of the high initial cost for GFRP RC bridge deck as compared to conventional steel RC deck;
      • USDOT to require emissions-reduction goals for funding recipients The US Department of Transportation is working on plans to require highway and transportation funding recipients to set and track carbon dioxide emissions-reduction goals as a condition of receiving money;
      • FHWA proposal: Emissions could gauge success of transportation projects The amount of emissions, along with congestion, traffic reliability and freight movement, could be used to evaluate the success of a transportation project under new rules proposed by the Federal Highway Administration. The agency has started a 90-day comment period in the proposal.
Roadmap

Expanded list of Potential Focus Areas (cont.):

14. Project Monitoring
   i. SMO monitoring Cedar Key Bulkhead rehab – Test Beams under cap (3 surface coatings of GFRP bars);
   ii. FSU-UM monitoring Halls River bulkheads, piles, bent caps and deck – Test beams under bulkhead (GFRP, CFRP, and BFRP);
   iii. Coordinate with FHWA for monitoring FRP under Fixing America’s Surface Transportation (FAST) Act.

15. Outreach and Technology Transfer:
   i. FDOT Transportation Innovation - FRP website;
   ii. FDOT Design Expos;
   iii. Project Case-Studies & Workshops.

**********
New items from FDOT-FRP Workshop (Feb 3, 2017)…

ACMA/FRP-RMC Industry Concerns

1. Necessary and required testing today versus years of test data compiled from other installations

2. Identification and selection process of testing laboratories which are ISO qualified. *(Comment: This has been proposed to be changed to “an independent laboratory approved by the Department” for the January 2018 Specs.)*

3. Government agencies and engineers that use products that may be interpreted by some as questionable, un-tested and does not meet the expected standards generated by ASTM, ACI, others

4. First costs versus cost premium impact to overall project cost. How is this handled from the owners stand point. Do life cycle costs play a role as identified in MAP-21?

5. Durability testing: field versus accelerated testing. Which will the DOT feel gives them the results they need? What is the DOT looking for?
Questions?

Safe Travels Home…