Outline

1. What problem are we trying to solve?
2. Are Composites the solution?
3. History of Seawall Development in Florida
4. Quantifying the Shoreline Legacy
5. New Challenges – SLR, Extreme Weather, Sustainability, Increased Durability Expectations
6. New Solutions – SEACON, GFRP-PC, BFRP
7. Example Projects in Florida
What Problem are we trying to solve?

Need for New Solutions for Corrosion Durability and Sustainability

Avoiding corrosion “concrete cancer”

- GFRP or SS rebar
- CFRP or HSSS prestressing strand

i. Justify by Cost-Benefit Analysis, LCC & LCA;
ii. Durability = Long Service Life;
iii. Challenges with new material systems:
   - Acquisition cost
   - Limited suppliers/competition;
   - Unfamiliar design criteria;
   - Unfamiliar construction practices.
What Problem are we trying to solve?

Example Costs of Corrosion (District 7- Tampa Bay Region)

Repair cost of bridges in District 7 (FY 2002/03 to 2012/13)

- 54 Bridge projects studied over ten year period
- (20 Steel Bridges and 34 Concrete Bridges)

Source: FDOT-D7 District Structures Maintenance Office & T.Y. Lin International
Are Composites the Solution?

Service Life Enhancement thru Durability:


- **75 years** under **AASHTO LRFD Bridge Design Specification** (1994 – present)

- **100 years+**, **SHRP2-R19A** “Bridges for Service Life beyond 100 Years: Innovative Systems, Subsystems and Components” *Design Guide for Bridges for Service Life*, Publication S2-R19A-RW-2, Section 3.2.2.10 FRP (2013)
History of Seawall Development in Florida for the Built-Environment…

(Photographs courtesy of the Burgert Bros.)
History of Seawall Development in Florida

Reinforced Concrete: since 1920's → Prestressed since late-1950's

Images from 1945 (Index 1962) & 1946 (Index 2039) Standards.
Florida State Road Dept. (FDOT)
History of Seawall Development in Florida

Prestressed Concrete: since late-1950’s …
Quantifying the Built-Shoreline Legacy

US Coastal State Shoreline Lengths (Miles)

(b) Sheltered coast
Hardened shoreline (%)
- 0.00–9.99
- 10.00–24.99
- 25.00–49.99
- 50.00–74.99
- 75.00–100.00

FDOT average unit rate of $61/sq.ft. (2009-2016).
Assuming 80% of the hardened shoreline (4460 miles or 7177 km) is concrete sheet pile with average exposed wall height 6 ft. & buried length is 12 ft. The total replacement cost in present day dollars is approx. US$21 Billion.
Quantifying the Built-Shoreline Legacy

Typical Examples:

• **City of Punta Gorda** (Punta Gorda Isles 1960’s-70’s = 91 miles; & Burnt Store Isles 1970’s-80’s = 18 miles)
  Total 109 miles (175 km) seawalls.

• [http://www.ci.punta-gorda.fl.us/services/canal-maintenance](http://www.ci.punta-gorda.fl.us/services/canal-maintenance)
New Challenges

SLR, Extreme Weather, Sustainability, Increased Durability Expectations

(a) Hurricane Ivan damage in Escambia Bay (2004)
(b) Hurricane Damage along A1A (2008)
(c) Hurricane Sandy damage along A1A in Fort Lauderdale (Photo: Susan Stocker, Sun Sentinel, 2012).
(d) Hurricane Mathew damage along A1A Flagler Beach, (2016)
(e) Brickell Ave under water during Hurricane Irma (2017)
New Solutions

SEACON... (2016-2018)

Sustainable concrete using seawater, salt-contaminated aggregates, and non-corrosive reinforcement

Seawater Immersion at 60°C

Compressive Strength (ksi)

Age (days)

Seawater Immersion at 60°C
New Solutions

CFRP Prestressing, since 2014 ...

i. Design criteria for prestressing – *Fiber Reinforced Polymer Guidelines (FRPG)* – Chapter 3;

ii. Developmental *Index D22440* (Nov. 2014)
   - (Halls River Bridge demonstration project);

iii. FDOT *FY2017-18 Design Standards* (Nov. 2016)
   - *Index 22440* series;
   - CFRP prestressing strands & GFRP stirrups;
   - Stainless Steel prestressed/reinforced alternative.
New Solutions

Future systems, …2020?

Developing design criteria for:

i. **Glass-FRP** prestressing;

ii. **Basalt-FRP** reinforcing;

FHWA’s *Innovations Deserving of Exploratory Analysis (IDEA)*

- GFRP Prestressing - **MILDGLASS** (University of Miami);

FHWA’s *State Transportation Innovation Councils (STIC)* Incentive Program

- BFRP Reinforcing Standards Development (*FDOT*)
Example Projects in Florida

1. Cedar Key SR24 Bulkhead Rehab.
   - Construction completed June 2016
   - Construction Project Overview

2. Halls River Bridge Replacement Project
   - Letting 6/15/2016
   - FDOT 2015 Design Expo Presentation
   - FDOT 2016 Design Expo Presentation

   - Bid June 2016 – Completed Sept 2018

4. Skyway South Rest Area Seawall Rehab.
   - Design-Build – 100% Plans
   - Under construction
QUESTIONS?

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