Seawall-Bulkheads, *SEACON*, Sustainability and Resilience

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FDOT

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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.


New and Old Seven-Mile-Bridge, (Florida Keys)


Courtney Campbell Causeway, seawall (Tampa Bay)

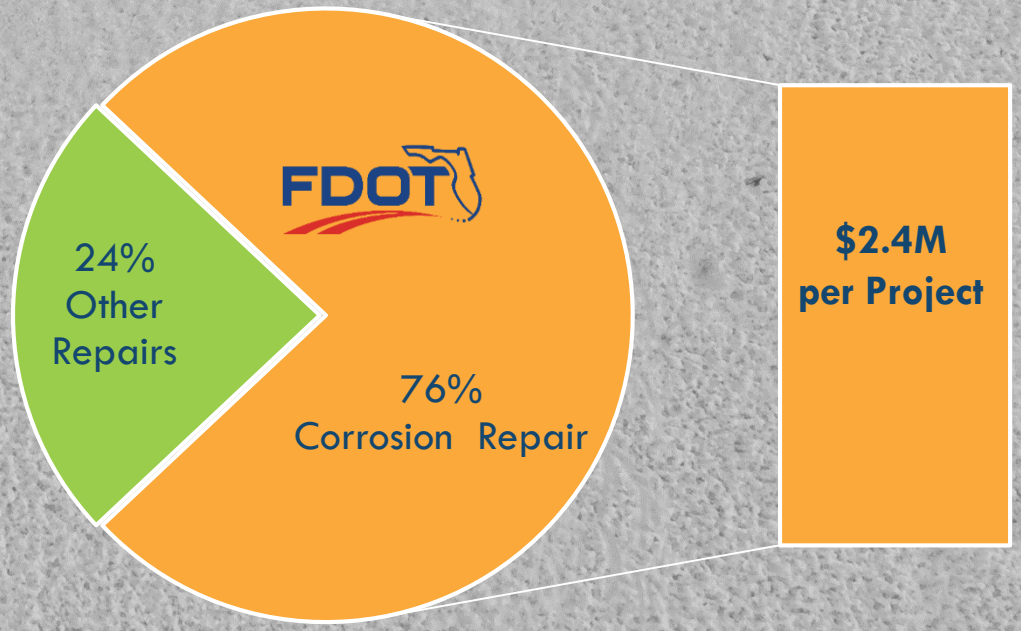

Gandy Blvd. seawall, (Tampa Bay)

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)

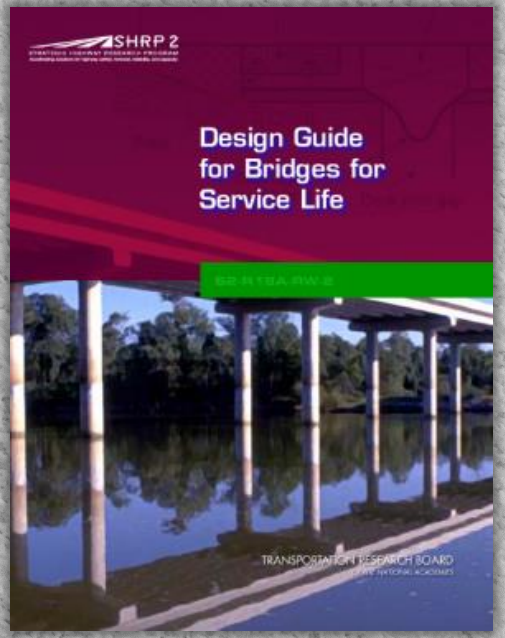


Source: FDOT-D7 District Structures Maintenance Office & T.Y. Lin International

Are Composites the Solution?

Service Life Enhancement thru Durability:

- **50 years** under ***AASHTO Standard Specification for Highway Bridges*** (1970's - 2002)
- **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

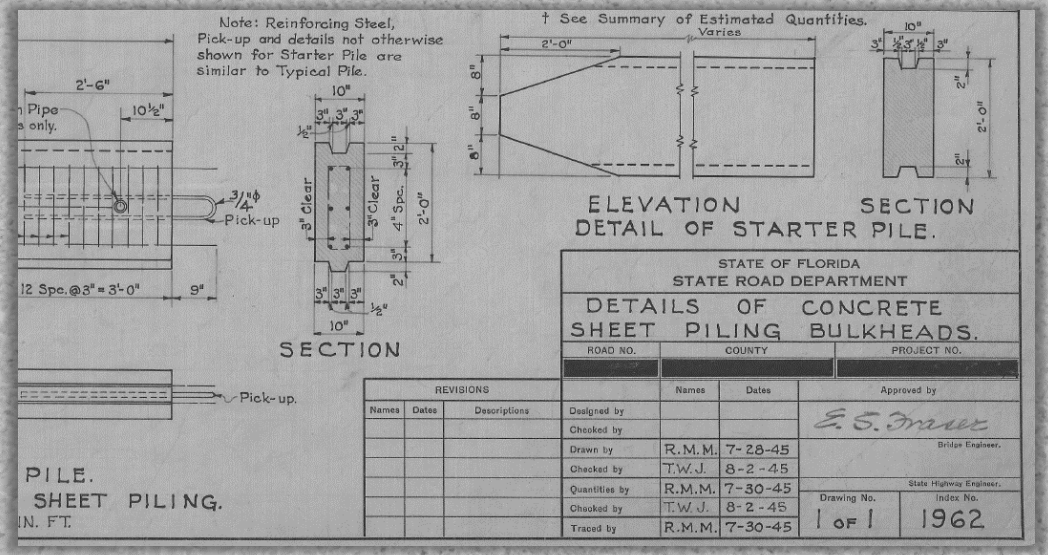
for the Built-Environment...

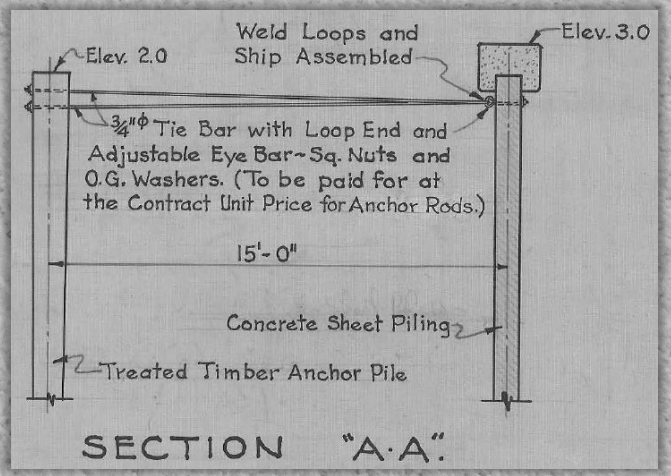
Davis Islands, PCA Concrete Piles Pub., pg.70 (1951)

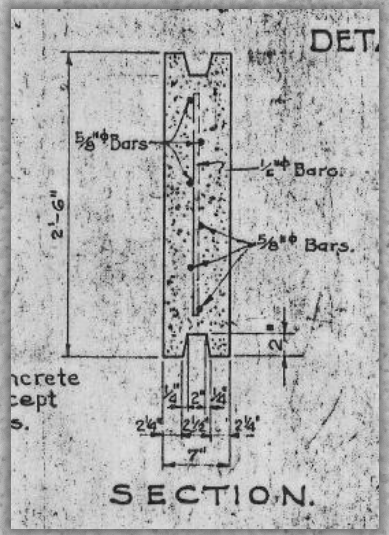
(Photographs courtesy of the Burgert Bros.)

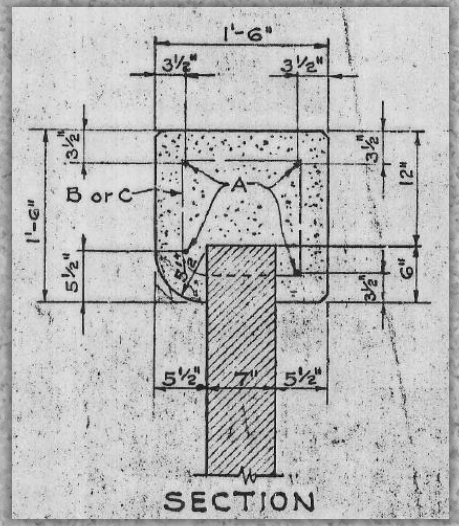
History of Seawall Development in Florida

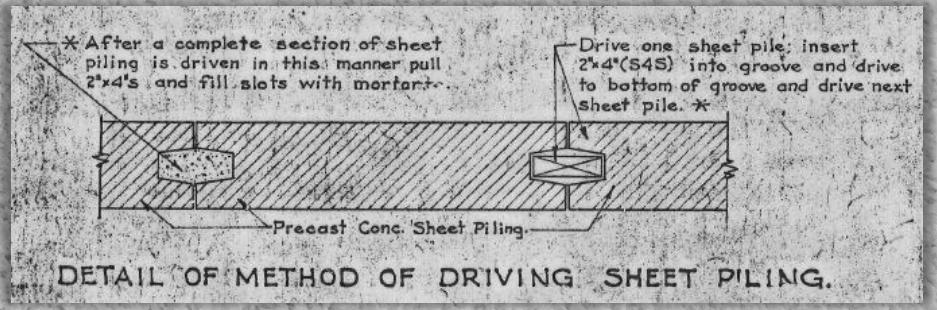
Reinforced Concrete: since 1920's → Prestressed since late-1950's









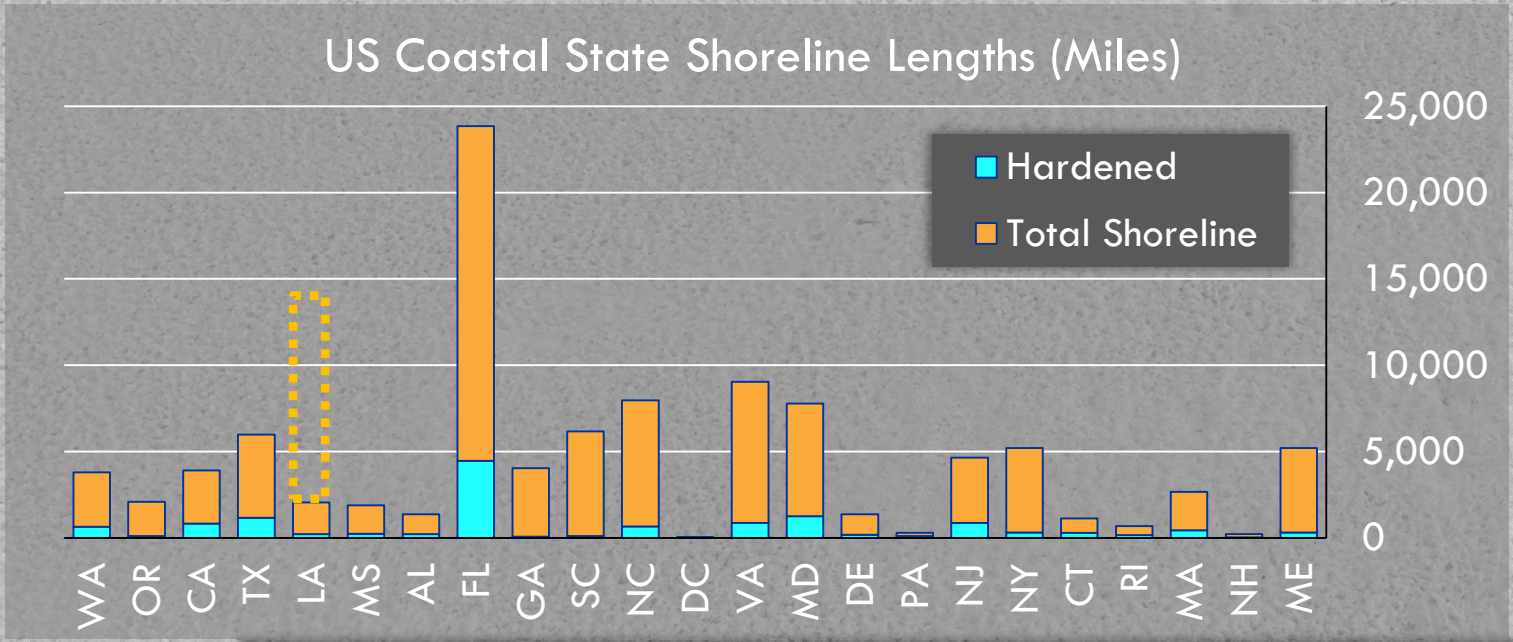


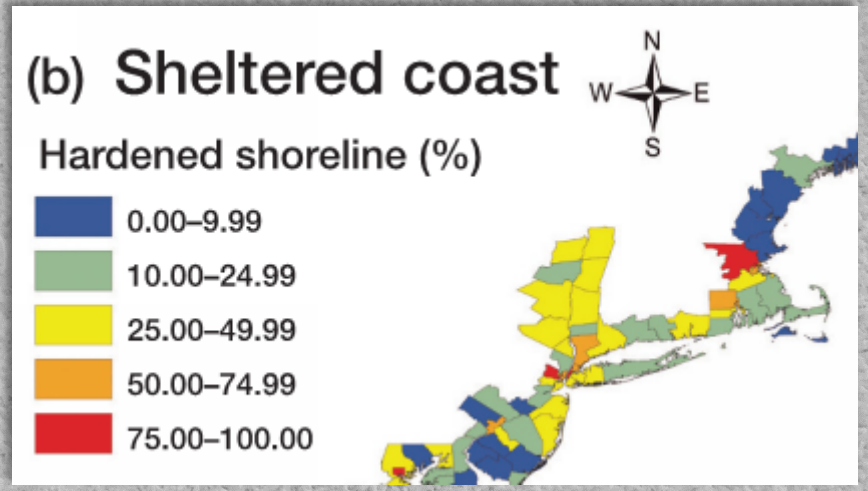
Images from 1945 (Index 1962) & 1946 (Index 2039) Standards.
Florida State Road Dept. (FDOT)

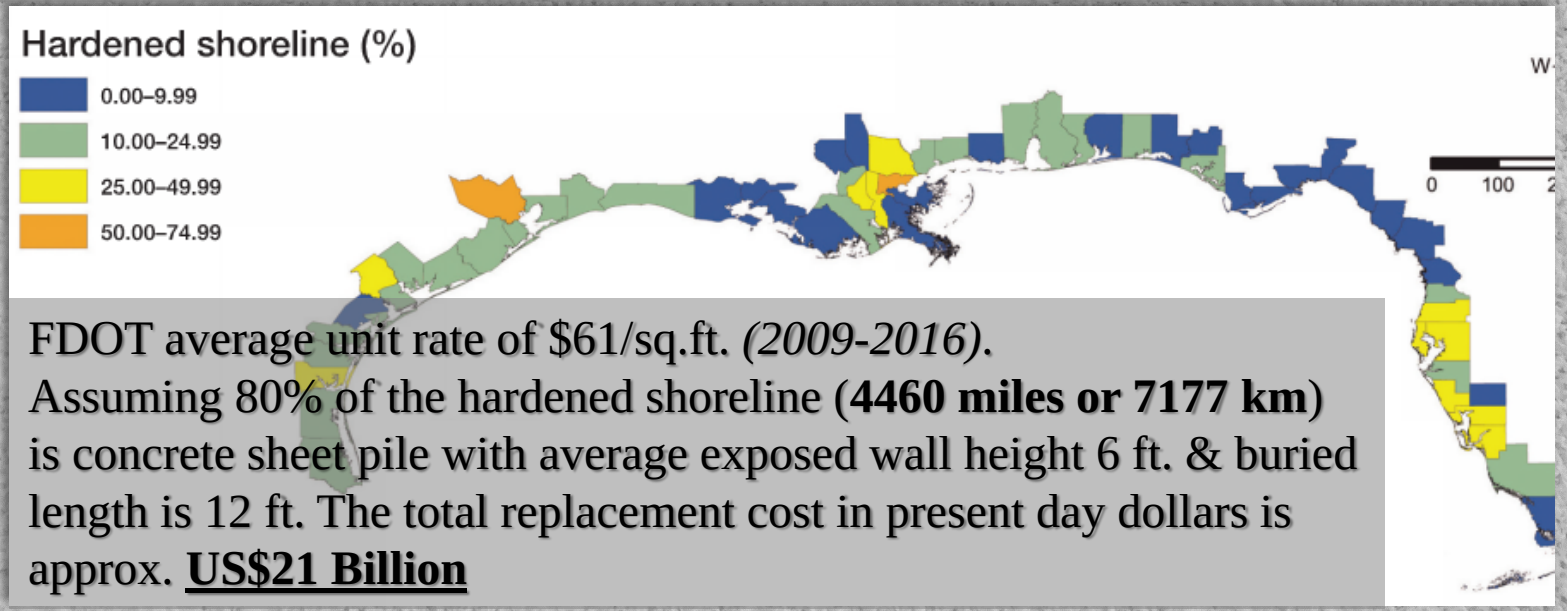
History of Seawall Development in Florida

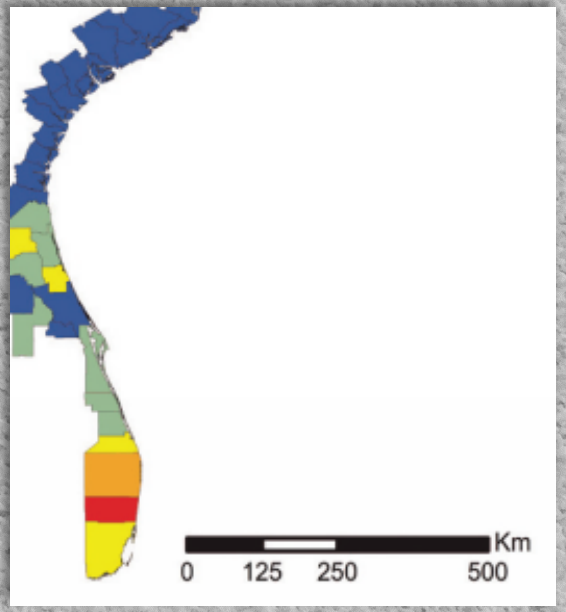
Prestressed Concrete: since late-1950's …

Quantifying the Built-Shoreline Legacy







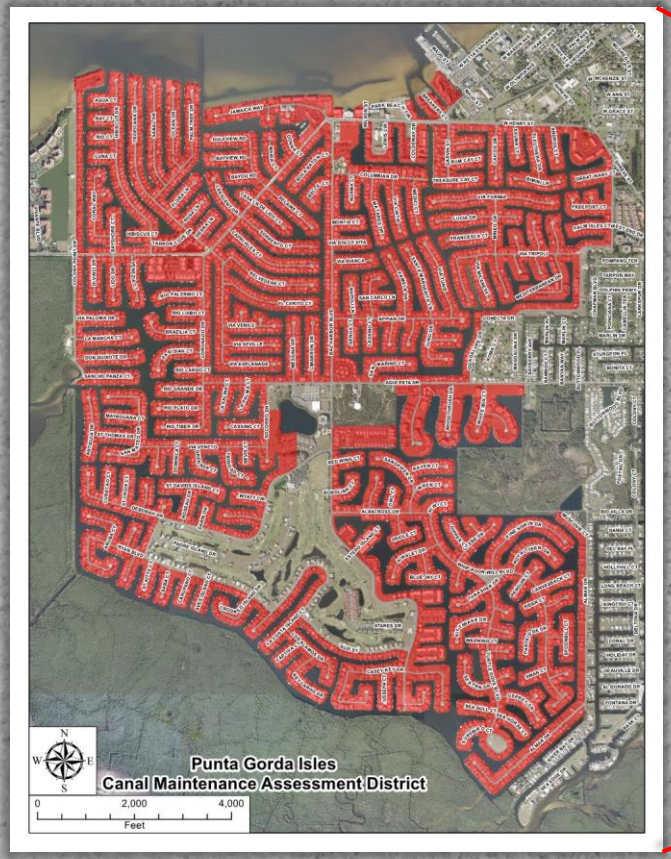


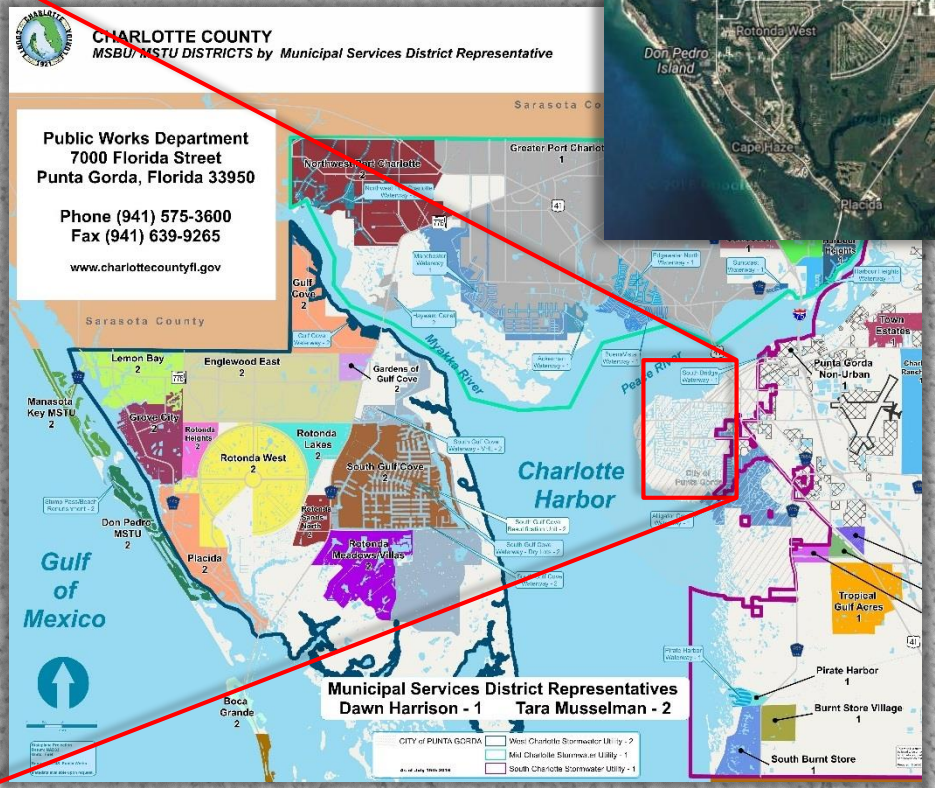
FDOT average unit rate of $61/sq.ft. *(2009-2016)*.
Assuming 80% of the hardened shoreline (**4460 miles or 7177 km**) is concrete sheet pile with average exposed wall height 6 ft. & buried length is 12 ft. The total replacement cost in present day dollars is approx. **US$21 Billion**

Quantifying the Built-Shoreline Legacy

Typical Examples:

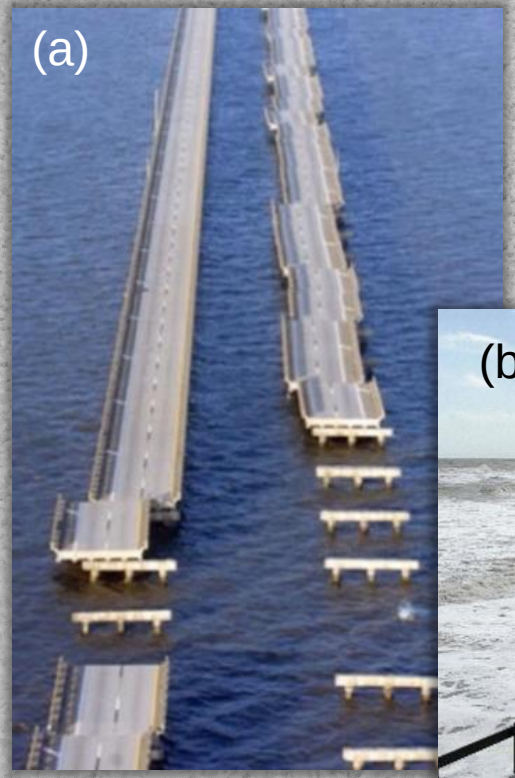
- **City of Punta Gorda** (Punta Gorda Isles 1960's-70's = 91 miles; & Burnt Store Isles 1970's-80's = 18 miles)
  Total 109 miles (175 km) seawalls.
- http://www.ci.punta-gorda.fl.us/services/canal-maintenance





New Challenges

SLR, Extreme Weather, Sustainability, Increased Durability Expectations

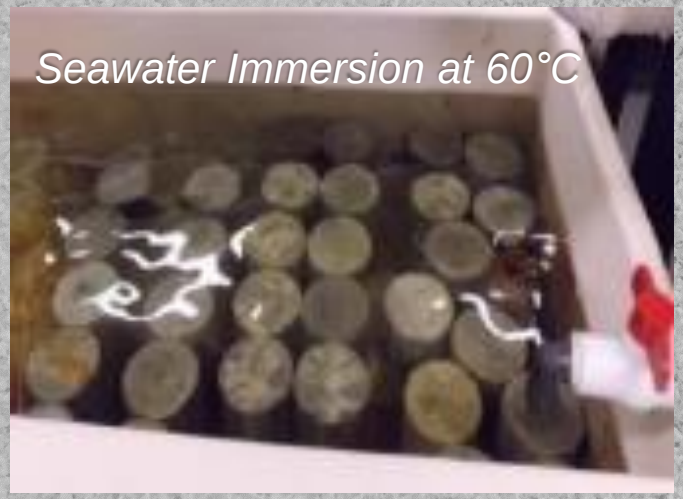


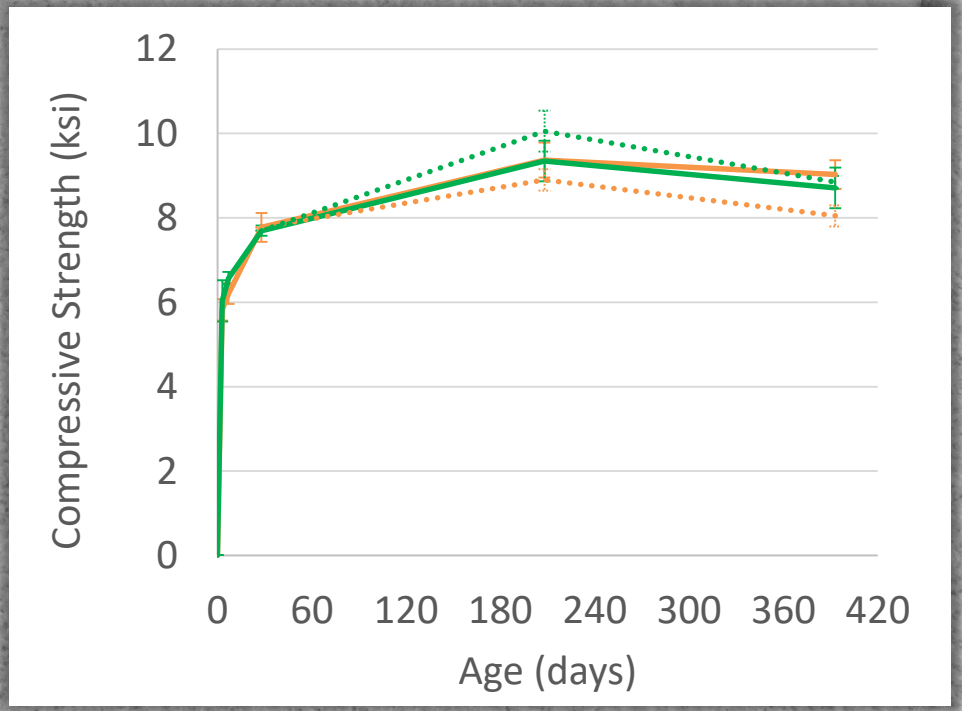
(a) Hurricane Ivan damage in Escambia Bay (*2004)*
(b) Hurricane Damage along A1A (*2008)*
(c) Hurricane Sandy damage along A1A in Fort Lauderdale (Photo: Susan Stocker, Sun Sentinel, 2012).
(d) Hurricane Mathew damage along A1A Flagler Beach, (*2016)*
(e) Brickell Ave under water during Hurricane Irma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

New Solutions

SEACON… (2016-2018)

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





New Solutions

CFRP Prestressing, since 2014 …

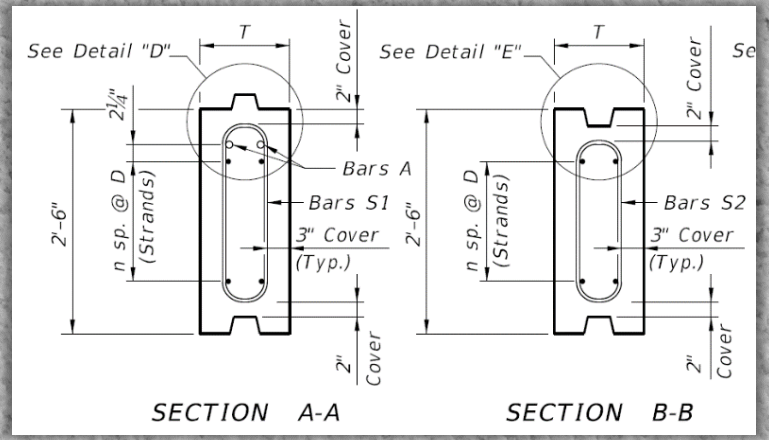
i. Design criteria for prestressing – ***Fiber Reinforced Polymer Guidelines*** ***(FRPG)*** *– Chapter 3*;

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 ***I****nnovations* ***D****eserving of* ***E****xploratory* ***A****nalysis* ***(IDEA)***

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

FHWA's ***S****tate* ***T****ransportation* ***I****nnovation* ***C****ouncils* ***(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

3. **Bakers Haulover Cut Bridge Bulkhead Rehab.**
   - Bid June 2016 – Completed Sept 2018

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

QUESTIONS ?

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