MCTI webinar (3/10/2021)

Innovative Structural Research & Demonstration Project implementation by the Florida DOT


GFRP rebar for deck & substructure of Halls River Bridge (2017-19)


GFRP Secant-Pile Shaft cages for A1A-Flagler Beach seawall (2019)


UHPC-PC H-Pile for CR-339 demonstration (2020)


CFRP-PC FSB's US-1/Cow Key span replacements (2020)

Prepared By: Will Potter & Steven Nolan

FDOT State Structures Design Office

ABSTRACT & SPEAKERS

Summary:

Florida DOT is privileged to have its own Structures Research Center (SRC) to assist in-house engineers, or contracted universities, and occasionally commercial producers with full scale structural element testing for applied research and demonstration purposes. Due to limited resources these activities are focused on mission critical activities often associated with innovative structural materials or systems.

Independent but cognizant of these activities, the Structures Design Office oversees a Design Innovation initiative which develops and monitors design guidance and demonstration projects for deployment of innovative structural materials and systems. This presentation will highlight some of the recent applied research coordinated by the SRC, outline the FDOT's innovative structural material implementation, and highlight some of the early demonstration projects.

Speakers: FDOT State Structures Design Office (Tallahassee)

***Will Potter**, P.E.: Assistant State Structures Design & Manager of Structures Research Center*

***Steven Nolan**, P.E.: Senior Structures Design Engineer*

Innovative Structural Research at FDOT

William E. Dean. In background is the Sebastian Inlet Bridge for which Dean received a special PCI Award in 1964.

Florida's History with Innovation and Research

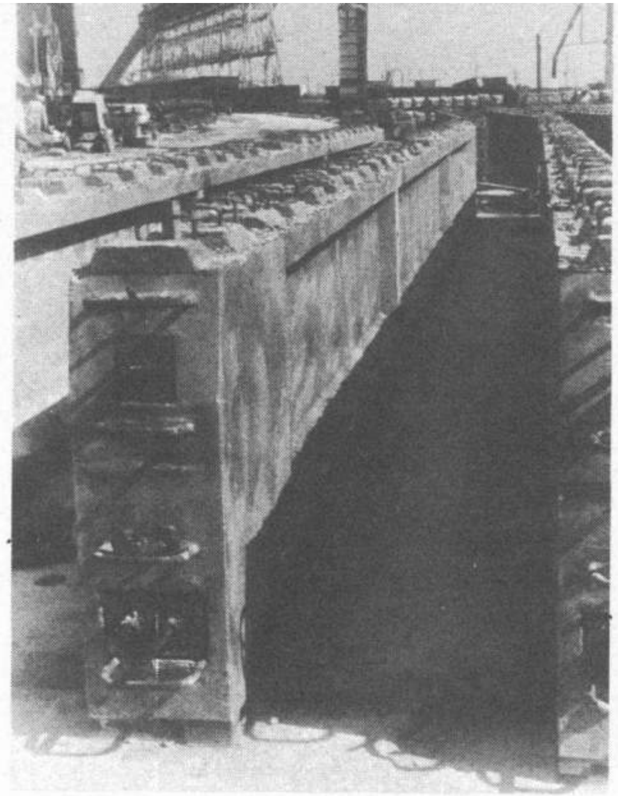


Fig. 26. Typical Tampa Bay beam

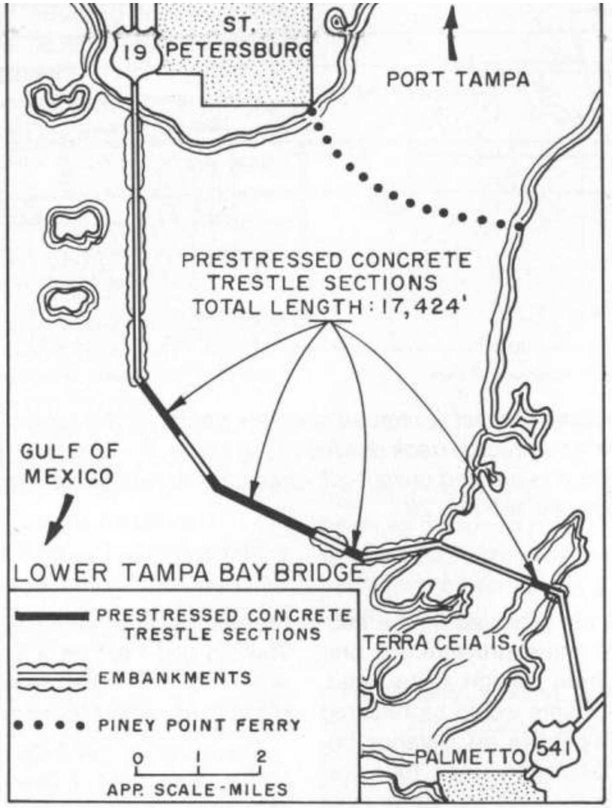


Fig. 21. Location map of Lower Tampa Bay Bridge

Fig. 25. Demonstration test cf 100-ft (30.5 m) long prestressed channel slab at R. H. Wright & Son, Fort Lauderdale, Florida.

Marcus H. Ansley FDOT Structures Research Center

Florida Department of Transportation

An Outline for
Structural Research and Development
Program

Prepared by:

Paul F. Csagoly

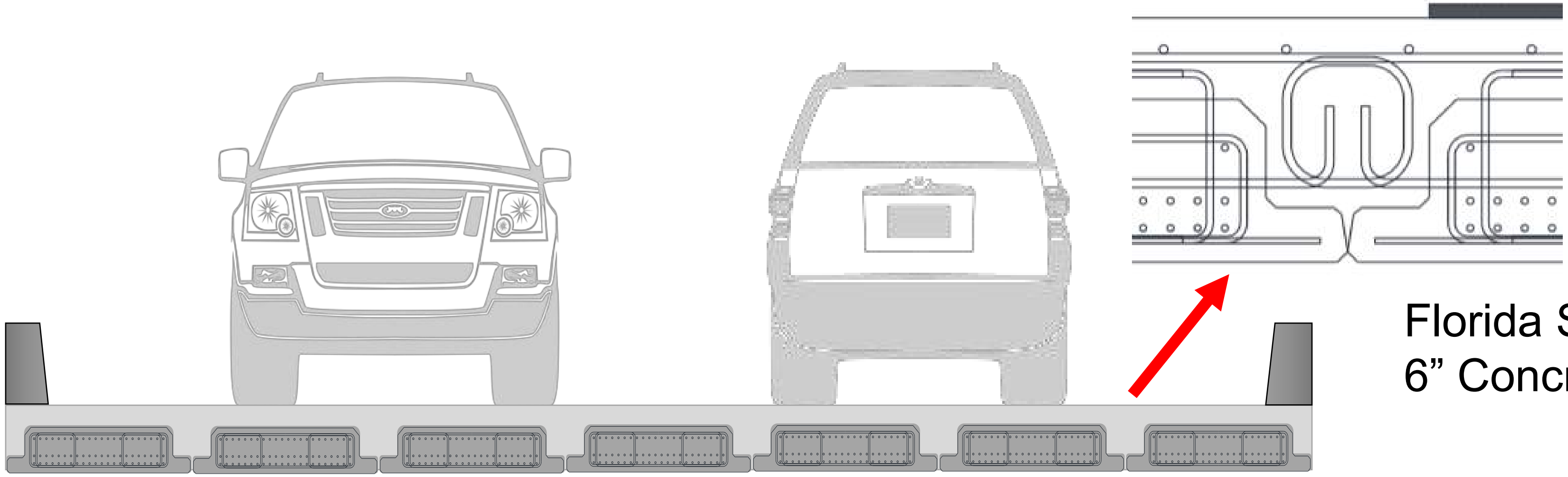
Date September 12, 1985

Structures Research Center Capabilities

- 11 Full Time Staff
  - 4 Engineers, 6 Technicians and 1 Admin Assistant

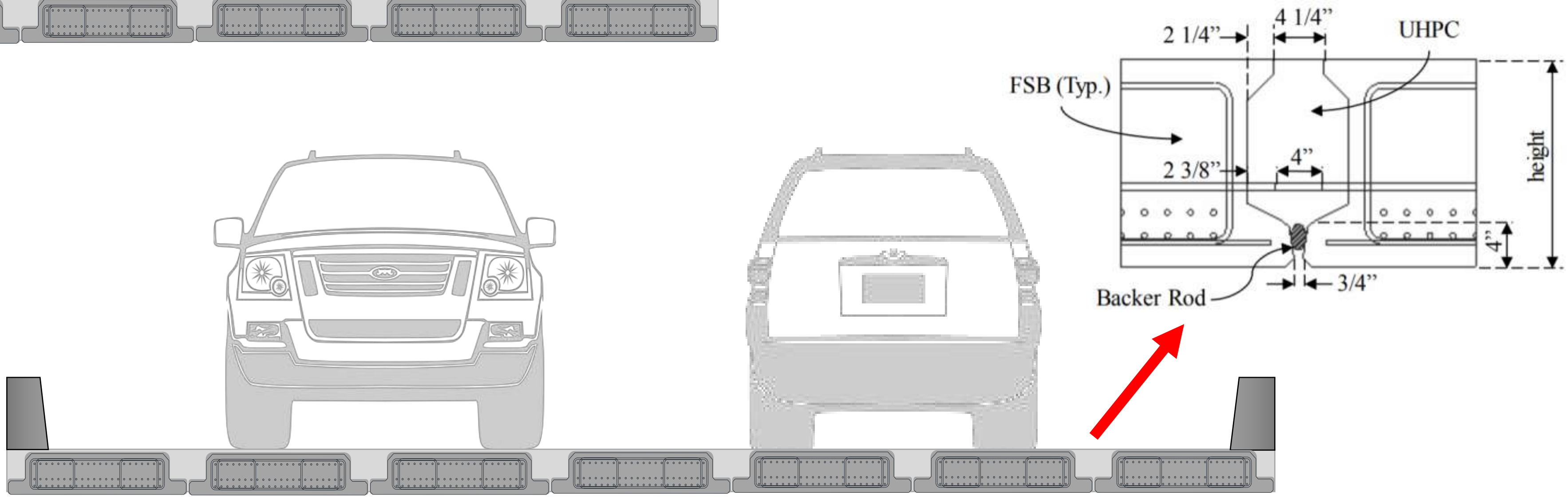
- 110-ft x 50-ft Strong Floor
- Outdoor Pendulum Facility
- Bridge Load Testing Program

Ultra-High-Performance Concrete (UHPC)

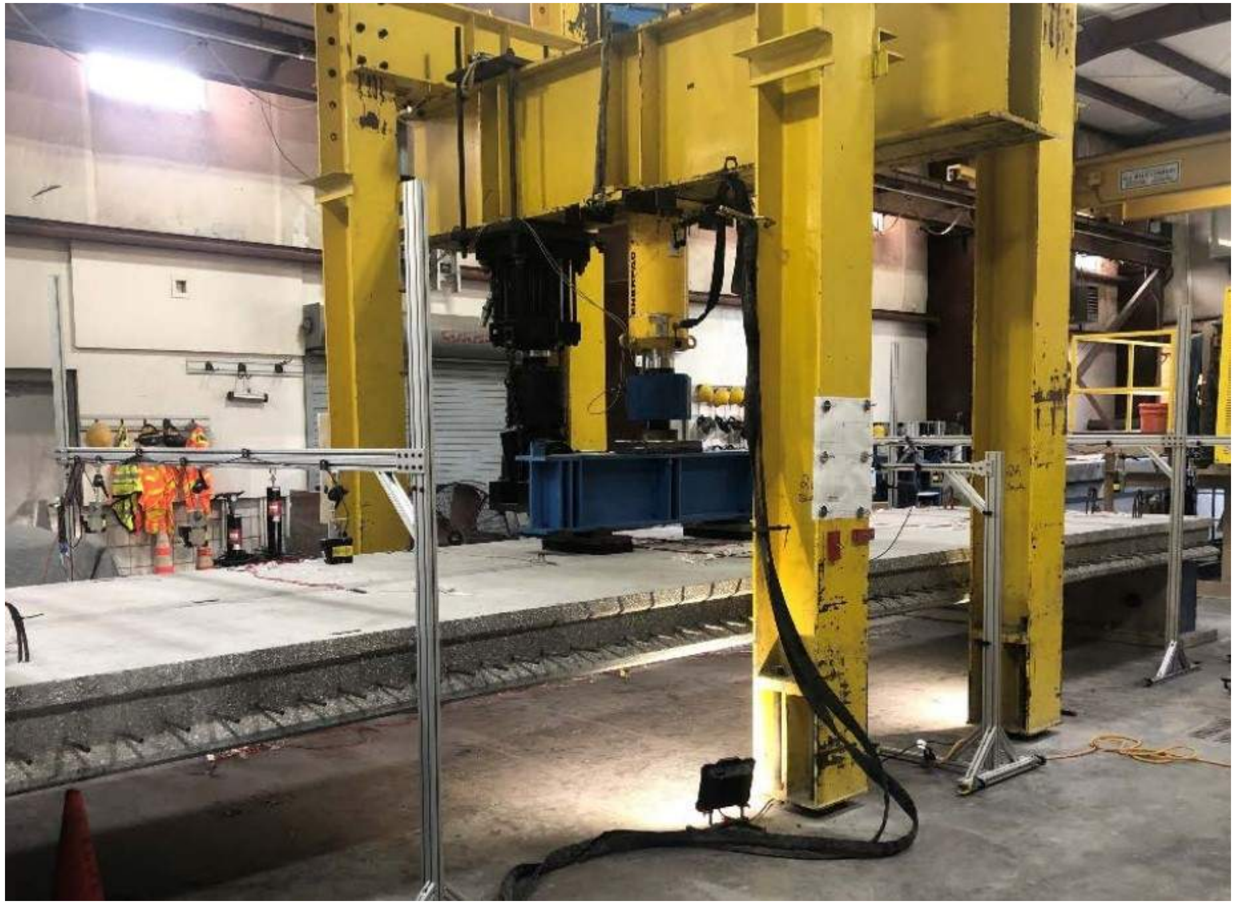


Florida Slab Beam with 6” Concrete Deck

Florida Slab Beam with UHPC Closure Pour



Florida Slab Beam w/ UHPC Joints



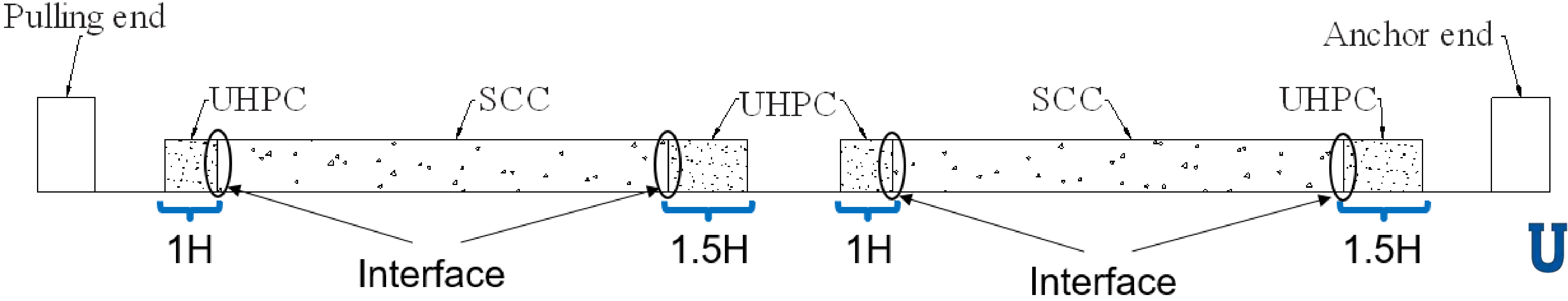
Strength Testing to Evaluate Overall Joint Integrity

Hybrid Prestressed Concrete Girder with UHPC

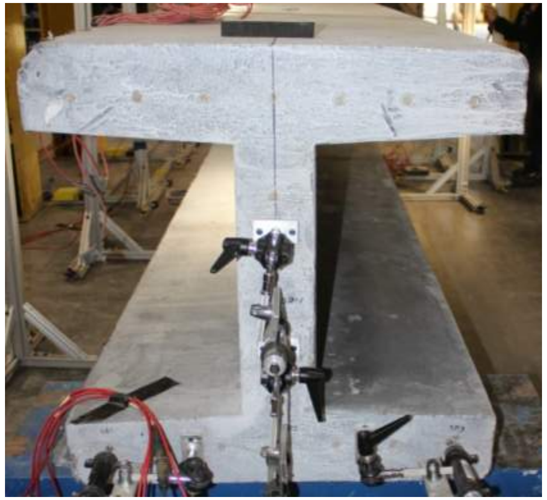
Objective

- Evaluate the effectiveness of UHPC to contribute to the structural performance of prestressed girders
- Reduce or eliminate visible end-region cracking

Hybrid Prestressed Concrete Girder with UHPC



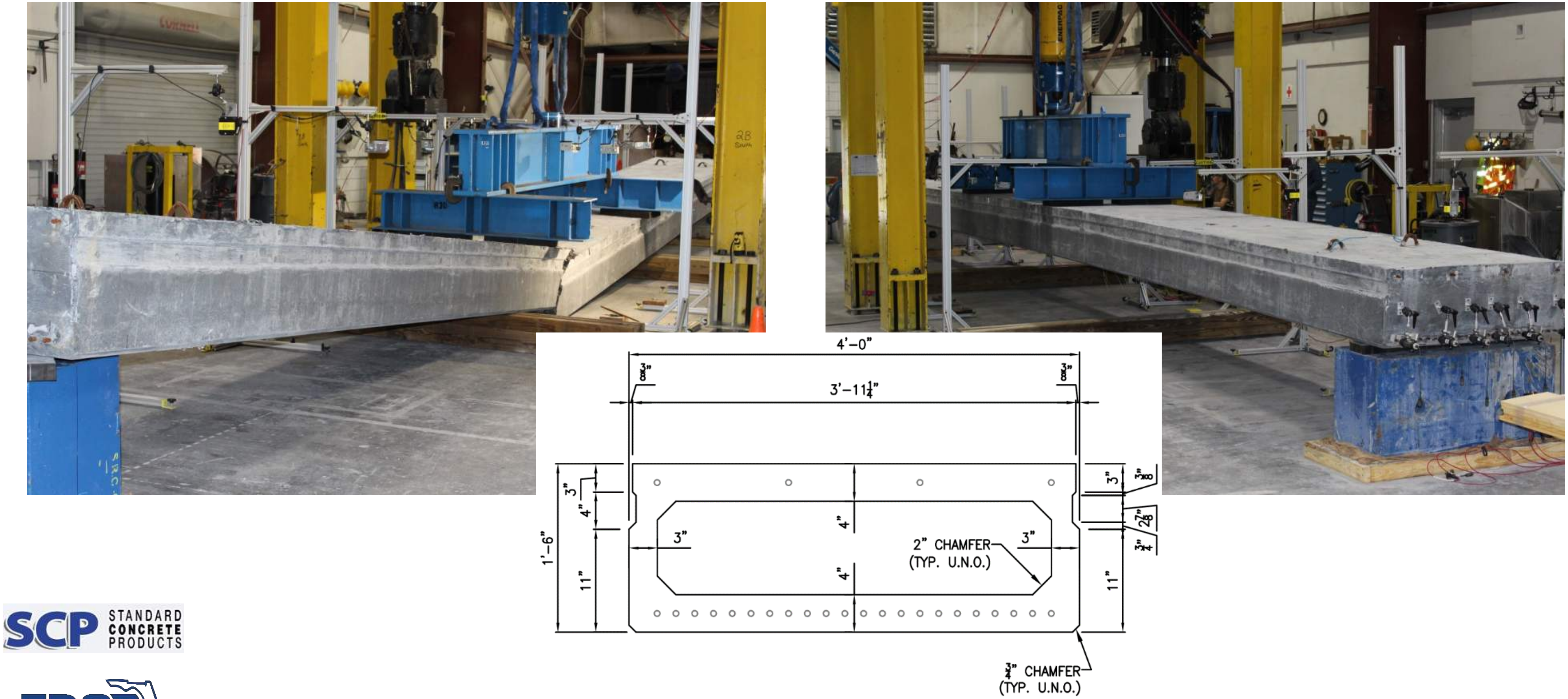
UHPC Industry Collaboration



- Collaborate with Florida Precaster’s to evaluate and test all UHPC Piling and Beam Concepts
- Florida is fortunate to have 2 Precaster’s that have UHPC mixes and willing to contribute to the state of knowledge

UHPC Industry Collaboration

UHPC Box Beam



Corrosion Resistant/Free Prestressed Piling

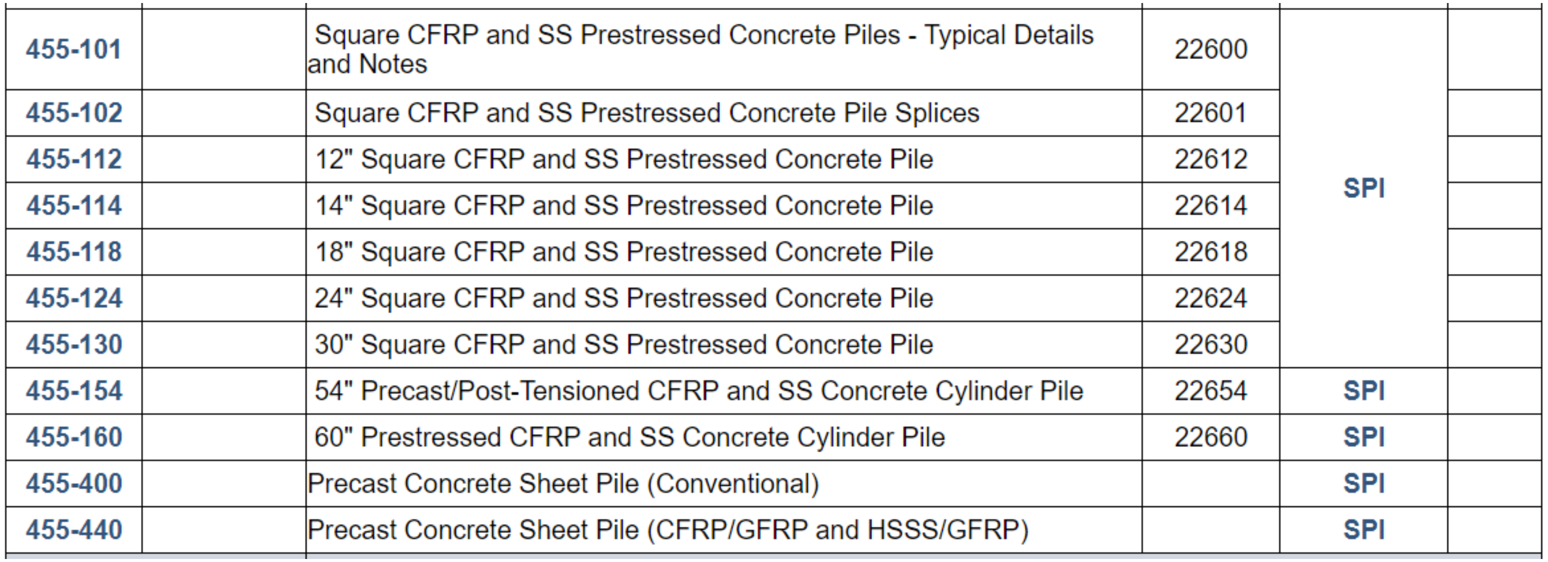
Carbon Fiber and High-Strength Stainless Steel Prestressed Piling

- Constructability
- Strength and Behavior Evaluation
  - Flexure
  - Shear
  - Transfer/Development Length
- Drivability
- Implementation
  - Standard Plans (455 series)

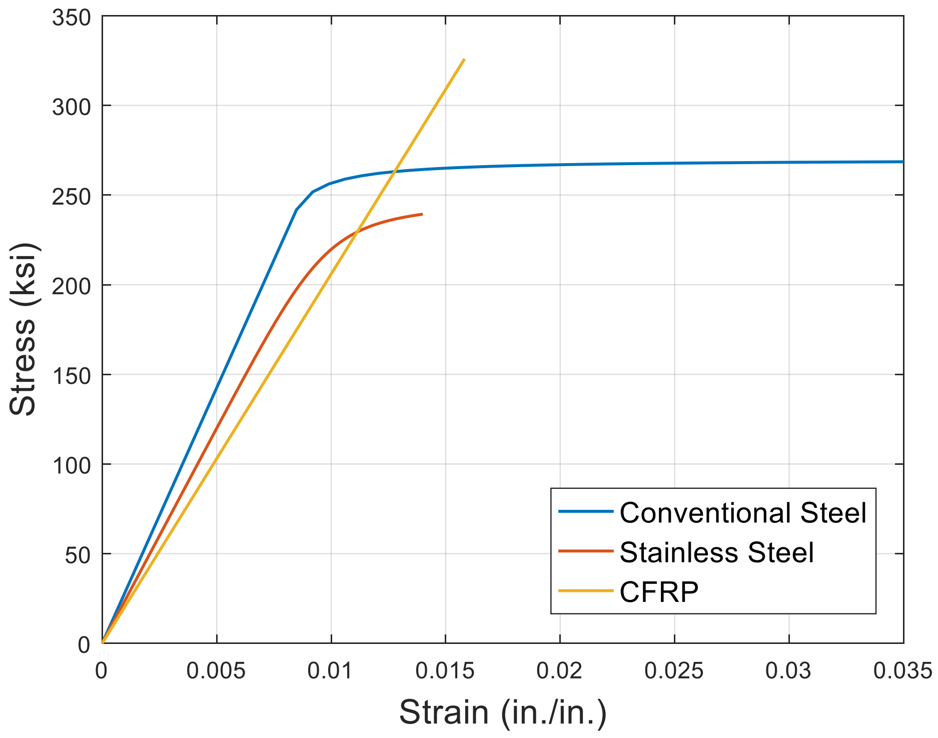
Corrosion Resistant/Free Prestressed Piling

	Duplex 2205 Alloy	ASTM A416 PC Strand	CFRP
Diameters (in)	0.375 to 0.7*	0.375 to 0.7	0.375 to 0.7**
Tensile Strength (ksi)	240	250, 270, 300+	300+
Elongation @ UTS	≥ 1.4% (1.4-2.0)	≥ 3.5% (5.0-7.0)	≥ 1.2%
Relaxation	< 2.5%	< 2.5%	< 6.0%
Elastic Modulus (ksi)	24,500	28,500	≥ 17,000

Standard Plans



455-101		Square CFRP and SS Prestressed Concrete Piles - Typical Details and Notes	22600	SPI	
455-102		Square CFRP and SS Prestressed Concrete Pile Splices	22601		
455-112		12" Square CFRP and SS Prestressed Concrete Pile	22612		
455-114		14" Square CFRP and SS Prestressed Concrete Pile	22614		
455-118		18" Square CFRP and SS Prestressed Concrete Pile	22618		
455-124		24" Square CFRP and SS Prestressed Concrete Pile	22624		
455-130		30" Square CFRP and SS Prestressed Concrete Pile	22630		
455-154		54" Precast/Post-Tensioned CFRP and SS Concrete Cylinder Pile	22654	SPI	
455-160		60" Prestressed CFRP and SS Concrete Cylinder Pile	22660	SPI	
455-400		Precast Concrete Sheet Pile (Conventional)		SPI	
455-440		Precast Concrete Sheet Pile (CFRP/GFRP and HSSS/GFRP)		SPI	



High-Strength Stainless Steel Prestressing - Flexural Applications -

Duplex 2205

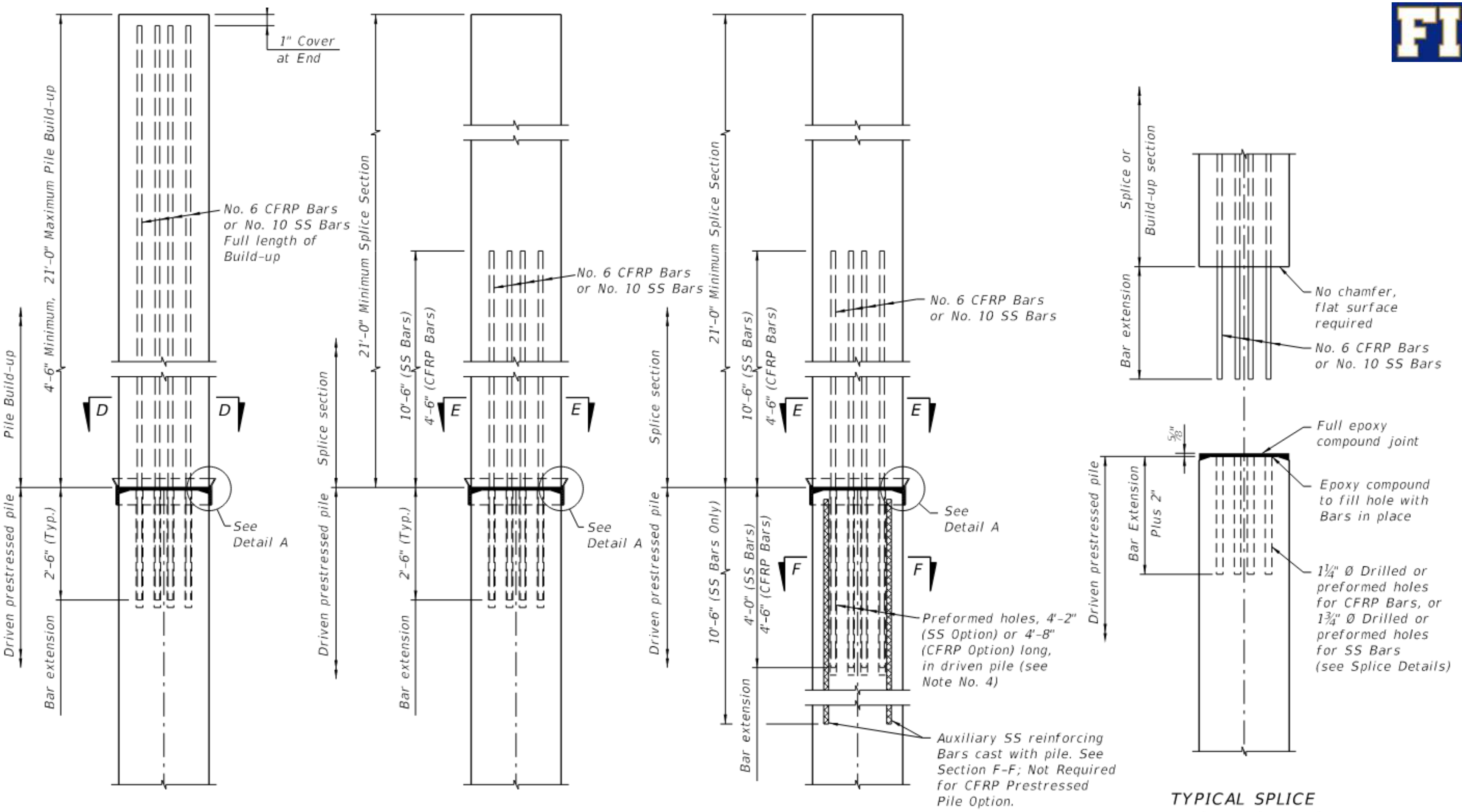
FAMU-FSU Engineering

High-Strength Stainless Steel Prestressing
- Flexural Applications -

High-Strength Stainless Steel Prestressing
- Flexural Applications -

FAMU-FSU Engineering

FRP Pile Splices (Unforeseen/Preplanned)



TYPICAL SPLICE
BEFORE BONDING

NONDRIVABLE UNFORESEEN
REINFORCED PRECAST
PILE BUILD-UP DETAIL

DRIVABLE UNFORESEEN
PRESTRESSED PRECAST
PILE SPLICE DETAIL

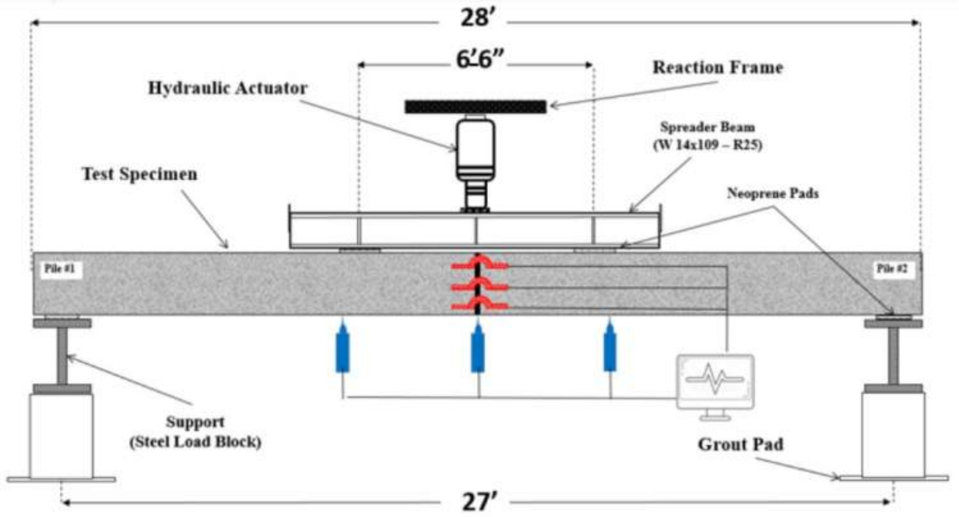
DRIVABLE PREPLANNED
PRESTRESSED PRECAST
PILE SPLICE DETAIL

Innovative Structural Research & Demonstration projects by the Florida DOT (2021)

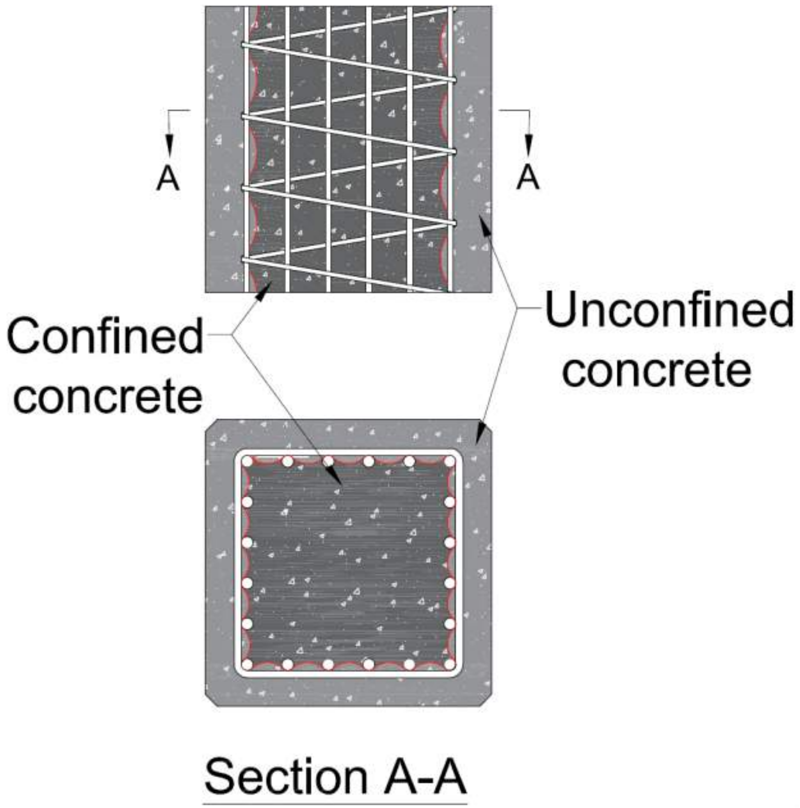
FRP Pile Splices (Unforeseen/Preplanned)

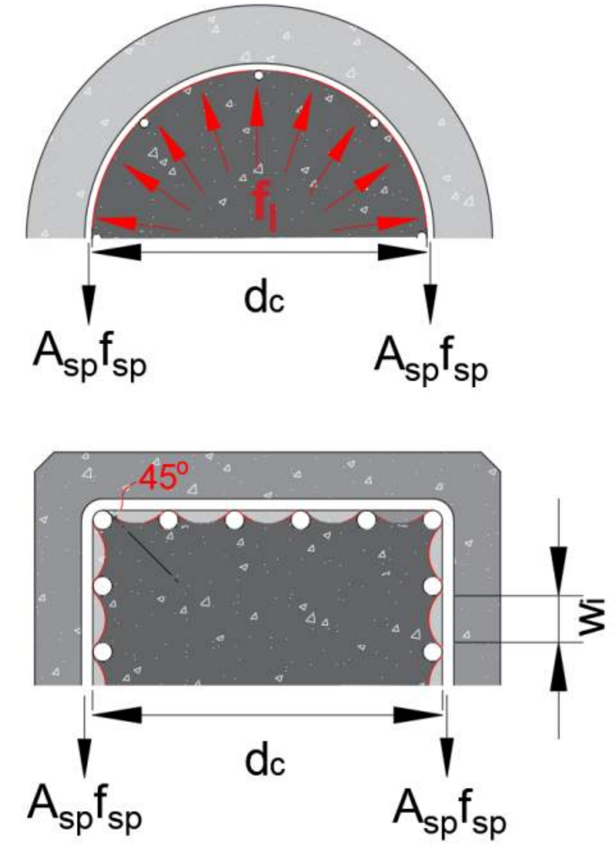
Testing based on comparison with conventional splices
Variables included:

- Splice dowel material (CFRP/GFRP/Steel)
- Splice length/method
  - Unforeseen or Preplanned
- Strand material

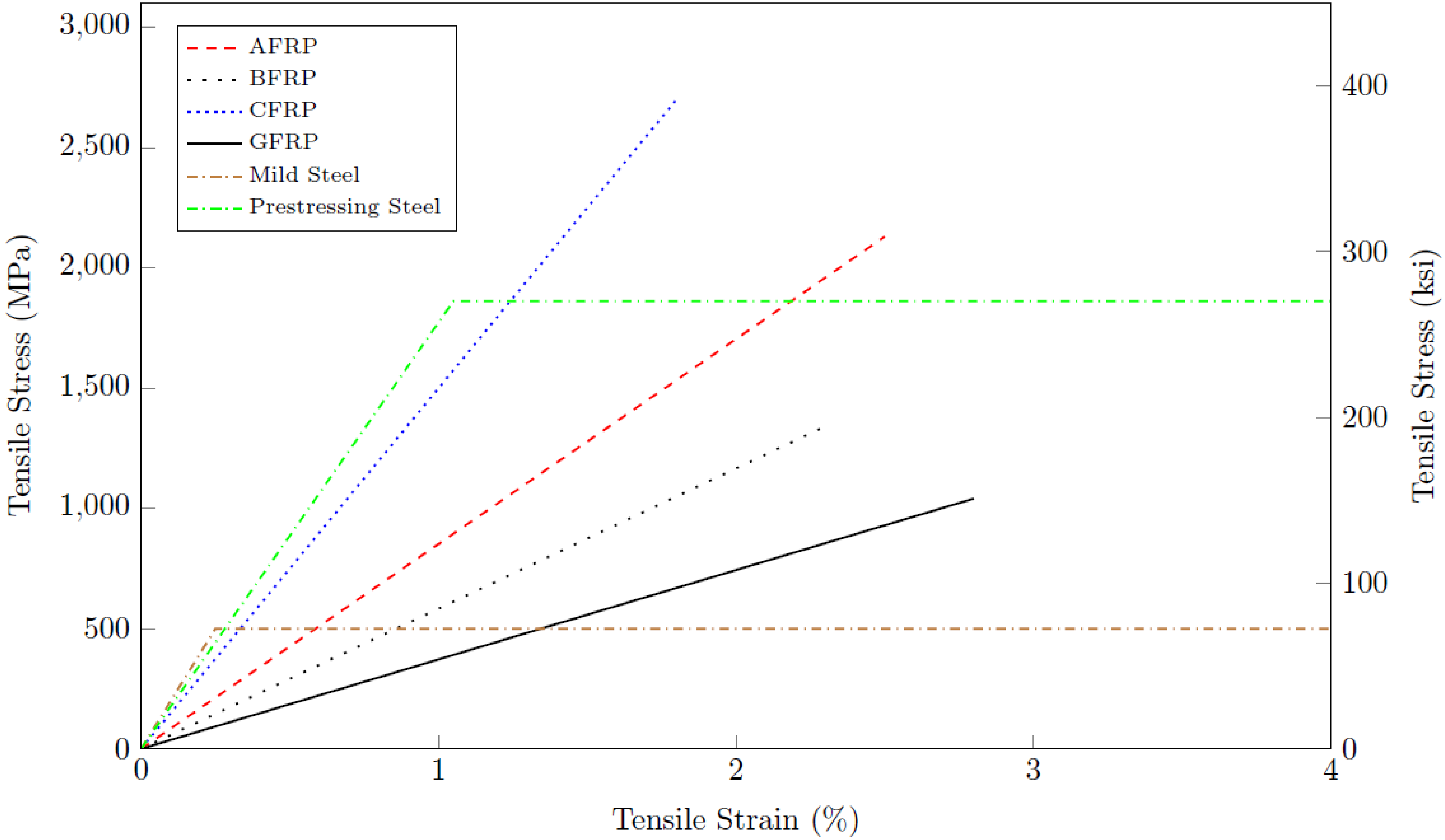


GFRP Spirals in Prestressed Piling



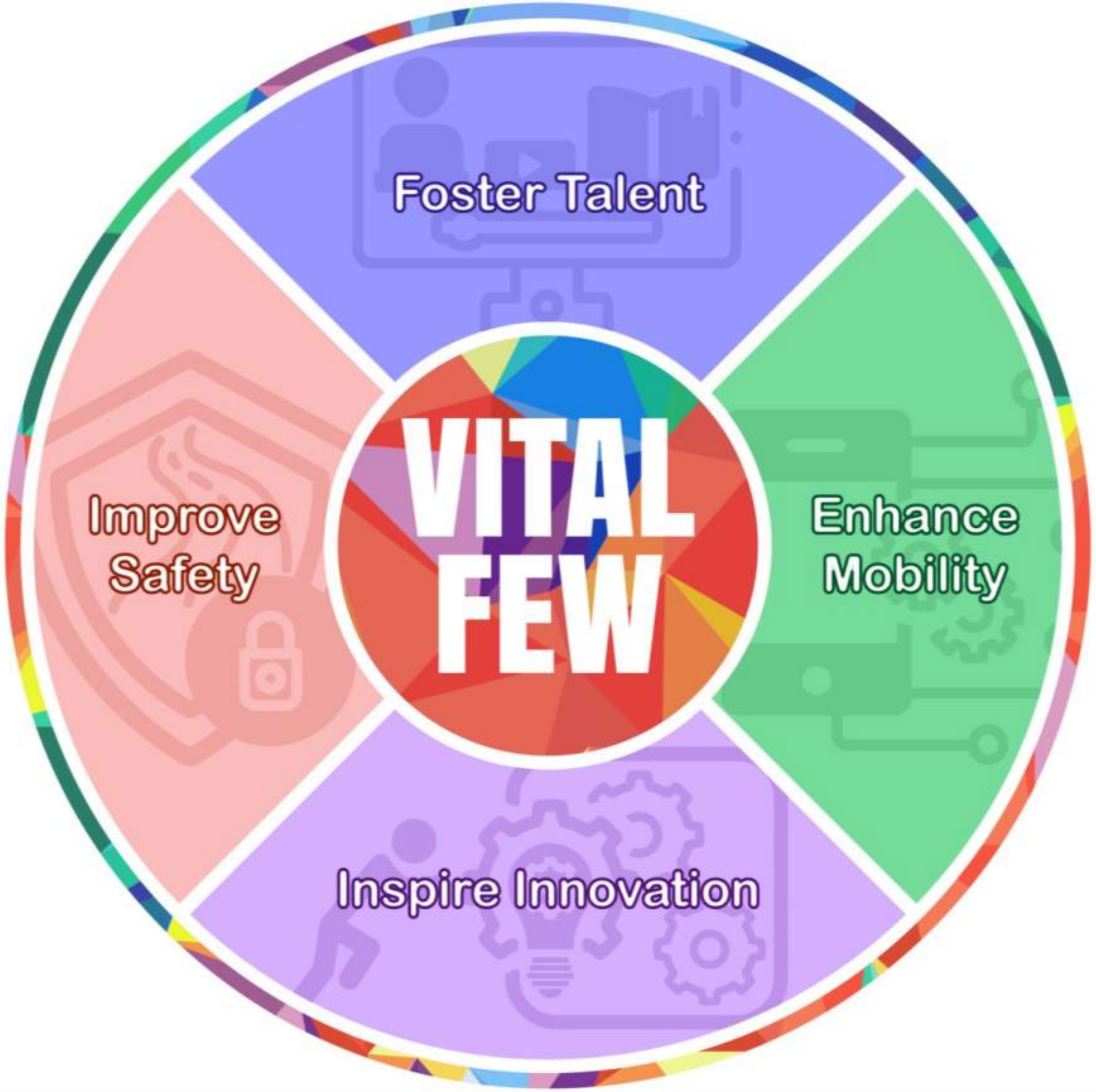


GFRP Spirals in Prestressed Piling



Innovative Structural Research & Demonstration projects by the Florida DOT (2021)

Agency Initiatives



Innovative Structural Materials Implementation

- **Why**
- **What**
- **How**

Why? Bridge Durability & Structural Advancement

- **Durability** needs – low-maintenance, extended service-life, cost-effective solutions, reducing work zones.

- **Structural** needs – Inspectable, repairable, robust, extended span lengths (light-weighting and/or high-strength & high-endurance):
  - HSSS-Prestressed Concrete *(2205 Duplex SS)*
  - CFRP-Prestressed Concrete *(Carbon strands)*
  - FRP-Reinforced Concrete *(Glass & Basalt)*
  - Ultra-High Performance Concrete *(UHPC)*
  - Light-weight Concrete or FRP *(Longer spans and/or less shipping cost)*

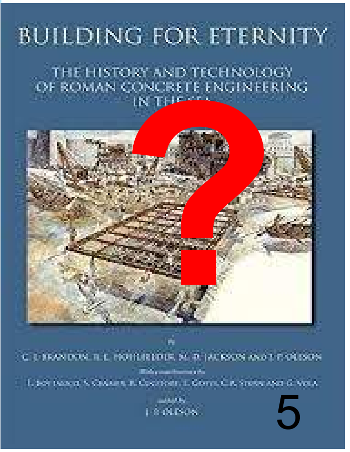
Highly Corrosion-Resistant (HCR)

Structural Advancement

WORK ZONES

Work zone fatalities make up approximately two percent of overall fatalities and two percent of serious injuries in Florida. Specifically, work zone crashes represented 385 fatalities and 2,414 serious injuries from 2015 to 2019, with the number trending upward over time. Work zone crashes compound the situation because of the risk they create to roadside workers who were present in the work zone in 35 percent of the fatal crashes and 44 percent of serious injury crashes. These crashes also can create tremendous disruption to roadways until they are cleared. Solutions include targeted enforcement in work zones, implementation of smart work zone applications, and efforts to educate drivers about work zone safety.

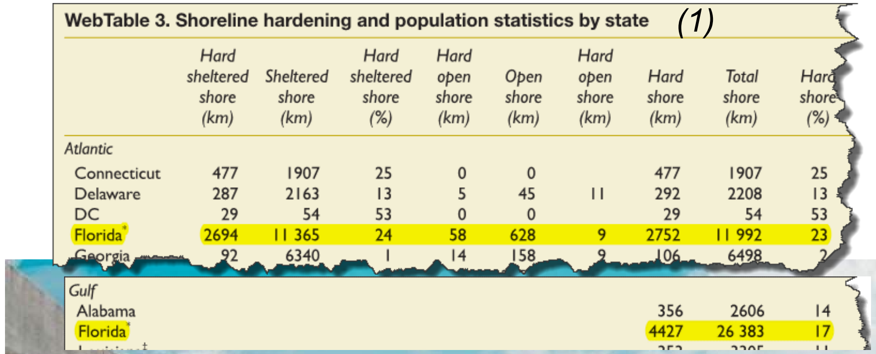
42 FLORIDA Strategic Highway Safety Plan


BUILDING FOR ETERNITY

THE HISTORY AND TECHNOLOGY OF ROMAN CONCRETE ENGINEERING IN THE SEA

Why use HCR materials for Bridges & Structures

- Florida maintains more than 150 million sq.ft. of bridge area *(7044 FDOT bridges^2);*
- Florida has more than 4,000 miles seawall-bulkheads^3.



WebTable 3. Shoreline hardening and population statistics by state *(1)*

	Hard sheltered shore (km)	Sheltered shore (km)	Hard sheltered shore (%)	Hard open shore (km)	Open shore (km)	Hard open shore (km)	Hard shore (km)	Total shore (km)	Hard shore (%)
Atlantic									
Connecticut	477	1907	25	0	0		477	1907	25
Delaware	287	2163	13	5	45	11	292	2208	13
DC	29	54	53	0	0		29	54	53
Florida*	2694	11 365	24	58	628	9	2752	11 992	23
Georgia	92	6340	1	14	158	9	106	6498	2
Gulf									
Alabama							356	2606	14
Florida*							4427	26 383	17

1982

1938

1912

Seven Mile Bridge "New" and Old (Florida Keys)

Jupiter (FL)

Lower Keys

Gandy Blvd. seawall (Tampa Bay)

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(1) Gittman et al. (2015) https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/150065

(2) FDOT Bridge Inventory – 2020 Annual Report

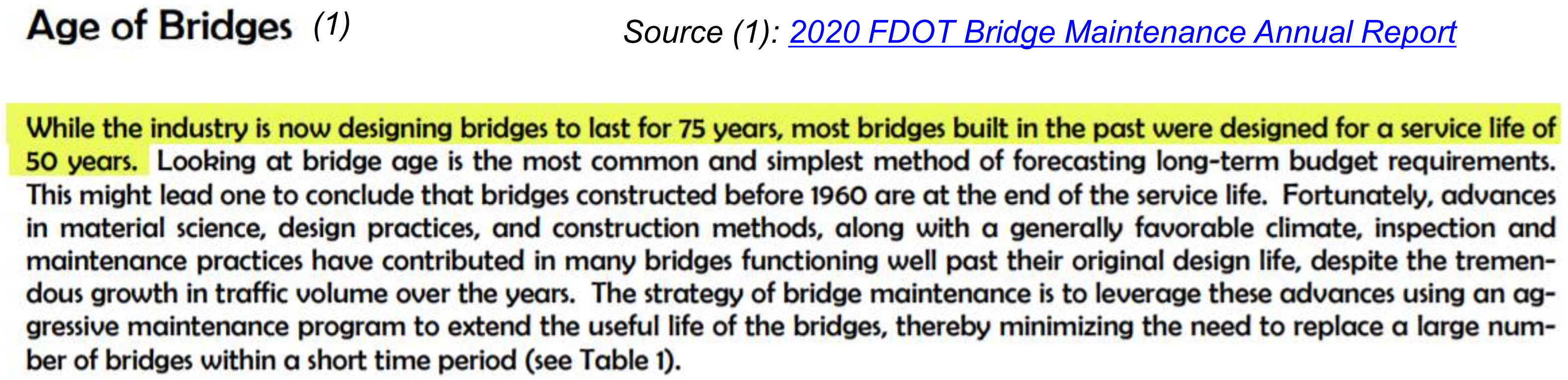
(3) Estimates from Gittman et al. (2015)

Why use HCR materials for Bridges & Structures

- Failure of structures exposed to aggressive environments is often corrosion of the steel reinforcement;
- Chlorides from air-borne salt or seawater penetrate concrete and reach steel rebar:
  - ✓ via concrete porosity
  - ✓ via cracks
- Corrosion is also accelerated by carbonation of concrete that lowers the pH;

+ FRP has low electro-magnetic interference (for electronic tolling)
+ FRP has low electrical conductivity (eliminates stray current corrosion)
+ FRP, SS & UHPC have lower ownership costs.

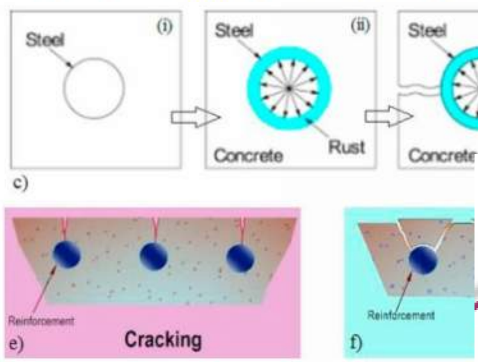
Why use HCR materials for Bridges & Structures



Age of Bridges (1)

Source (1): [2020 FDOT Bridge Maintenance Annual Report]()

While the industry is now designing bridges to last for 75 years, most bridges built in the past were designed for a service life of 50 years. Looking at bridge age is the most common and simplest method of forecasting long-term budget requirements. This might lead one to conclude that bridges constructed before 1960 are at the end of the service life. Fortunately, advances in material science, design practices, and construction methods, along with a generally favorable climate, inspection and maintenance practices have contributed in many bridges functioning well past their original design life, despite the tremendous growth in traffic volume over the years. The strategy of bridge maintenance is to leverage these advances using an aggressive maintenance program to extend the useful life of the bridges, thereby minimizing the need to replace a large number of bridges within a short time period (see Table 1).



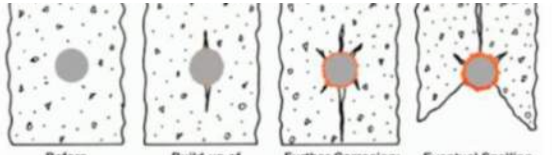


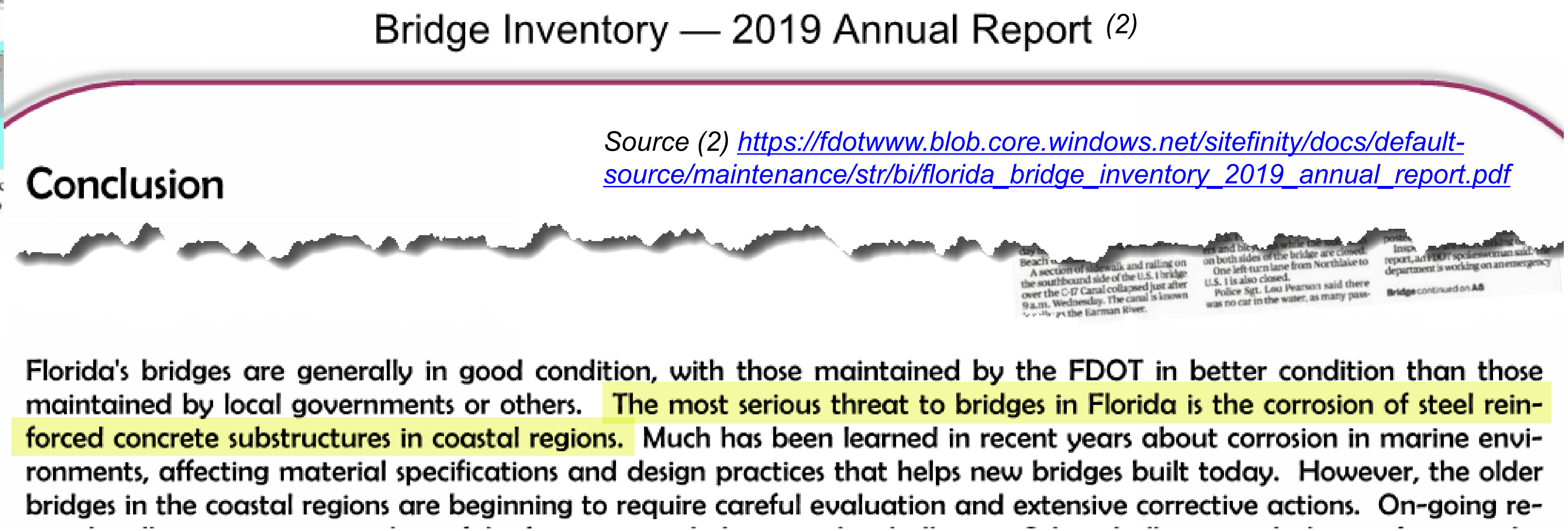
Figure 1. a) Components for corrosion; b) Electro-chemic
cracks as corrosion progresses; e) Cracks due to

Figure 1 from: Corrosion Mechanism in Reinforced Concrete(from Maia & Alves, 2017)

POST IN-DEPTH BRIDGE COLLAPSE

Portion of U.S. 1 bridge collapses in North Palm

Part of sidewalk, railing fall into canal after two post-tension wires fail.



Bridge Inventory — 2019 Annual Report (2)

Source (2) [https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/maintenance/str/bi/florida_bridge_inventory_2019_annual_report.pdf]()

Conclusion

A section of sidewalk and railing on the southbound side of the U.S. 1 bridge over the C-17 Canal collapsed just after 9 a.m. Wednesday. The canal is known

on both sides of the bridge are closed. One left-turn lane from Northlake to U.S. 1 is also closed.

Police Sgt. Lou Pearson said there was no car in the water, as many pass-

report, an FDOT spokeswoman said: the department is working on an emergency

Bridge continued on **A8**

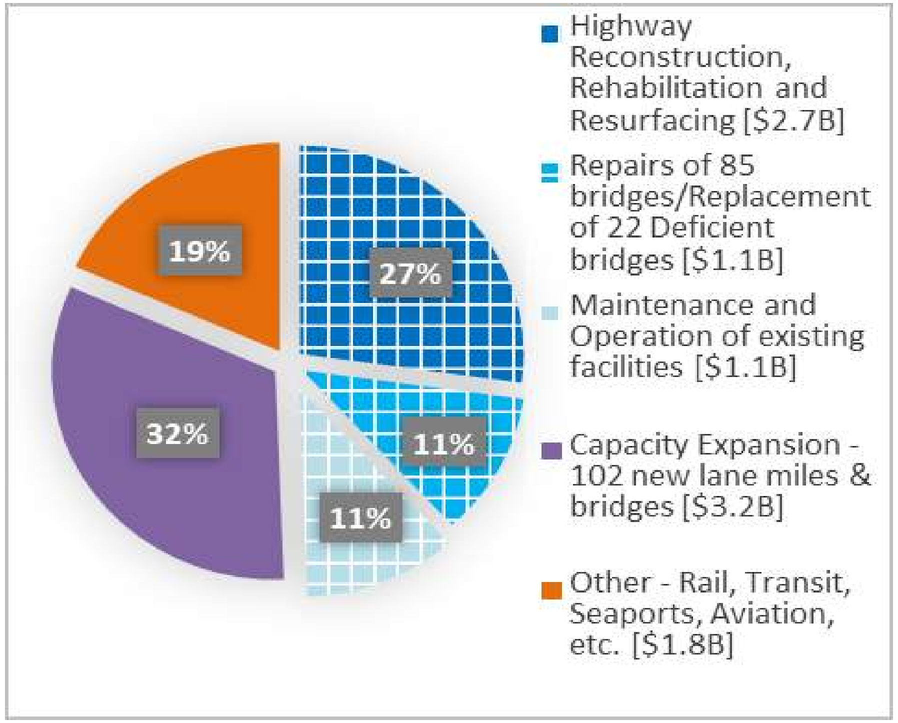
Florida's bridges are generally in good condition, with those maintained by the FDOT in better condition than those maintained by local governments or others. The most serious threat to bridges in Florida is the corrosion of steel reinforced concrete substructures in coastal regions. Much has been learned in recent years about corrosion in marine environments, affecting material specifications and design practices that helps new bridges built today. However, the older bridges in the coastal regions are beginning to require careful evaluation and extensive corrective actions. On-going re-

Innovative Structural Research & Demonstration Project implementation by the Florida DOT (2021)

Why use HCR materials for Bridges & Structures

Florida DOT Transportation Budget FY 2019/2020

- ~50% for combined Maintenance, Operations, Repair, Rehabilitation and Deficient Bridge Replacement *(hatched areas).*



Tent. FY 2021/22

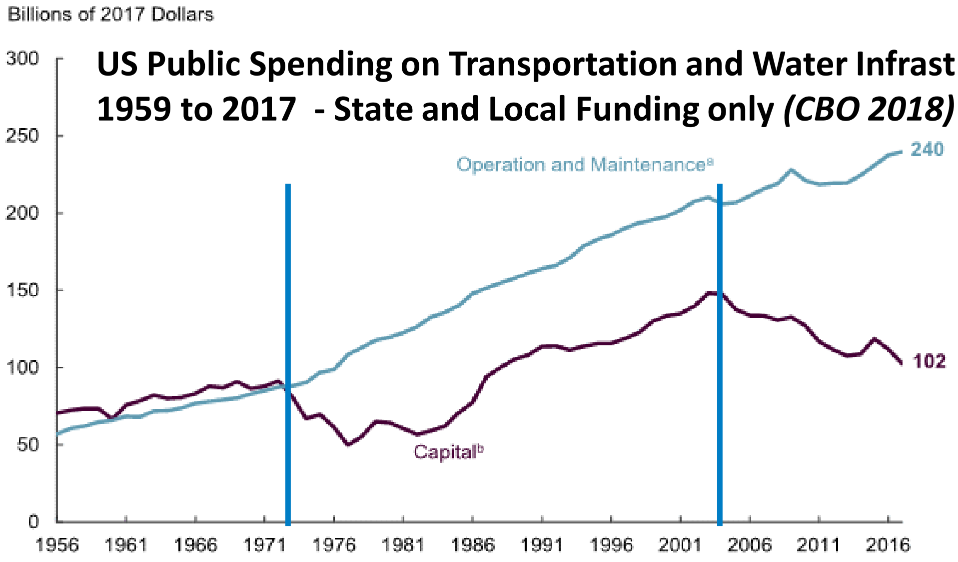
[$1B ?]

(89/18)
[$0.5B]

[$xxx]

210 miles
[$2.5B]

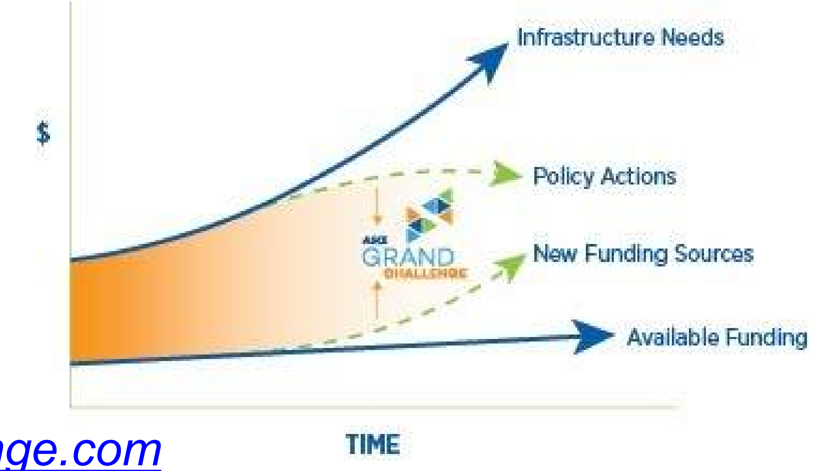
[$1.2B]



US Public Spending on Transportation and Water Infrastructure 1959 to 2017 - State and Local Funding only *(CBO 2018)*

2021 REPORT CARD FOR AMERICA'S INFRASTRUCTURE
ASCE

"Reduce the life cycle cost of infrastructure by 50% by 2025 and foster the optimization of infrastructure investments for society"



www.ASCEgrandchallenge.com

What? Bridge Durability & Structural Advancement

Office of Design

Office of Design / Design Innovation

Design Innovation

Non-Corrosive

The Florida Department of Transportation (FDOT) continually strives to enhance all areas of its operations. In support of these efforts, the department recently moved into a bold new era for innovative ideas, research and accelerated implementation. Success will depend on our ability to carefully evaluate or implement the products and services provided to the users of Florida's transportation system. Our goal is to utilize newly developed technology or employ creative thinking to generate greater value for every transportation dollar invested.

After researching and evaluating many innovative ideas, the Central Office has developed a list of concepts, products and services that may be the best solution to the project's needs or design challenges. Some items on the list are completely developed, and only need tailoring to your project. We encourage you to propose one or more of these innovations for project specific solutions with confidence of approval by the Districts. Other items are not fully detailed and will require coordination with and approval by the District's Design Office. Many of these innovations have been successfully implemented in other states and countries. Not all projects benefit from these innovations and the Department is not advocating the general use of new products or designs where an economical well proven solution exists and is the most appropriate solution for the situation.

FDOT Transportation Innovation Challenge

Highly Corrosion-Resistant

The Department invites you to share your thoughts on ways we can challenge ourselves to be innovative, efficient and exceptional at our **Invitation to Innovation website**

"invitation-to-innovation"

https://www.fdot.gov/agencyresources/innovation/default.shtm

Structures Design Office

Curved Precast Spliced U-Girder Bridges

Fiber Reinforced Polymer Reinforcing

FRP Members and Structures

Geosynthetic Reinforced Soil Integrated Bridge System

Geosynthetic Reinforced Soil Wall

Prefabricated Bridge Elements and Systems

Segmental Block Walls

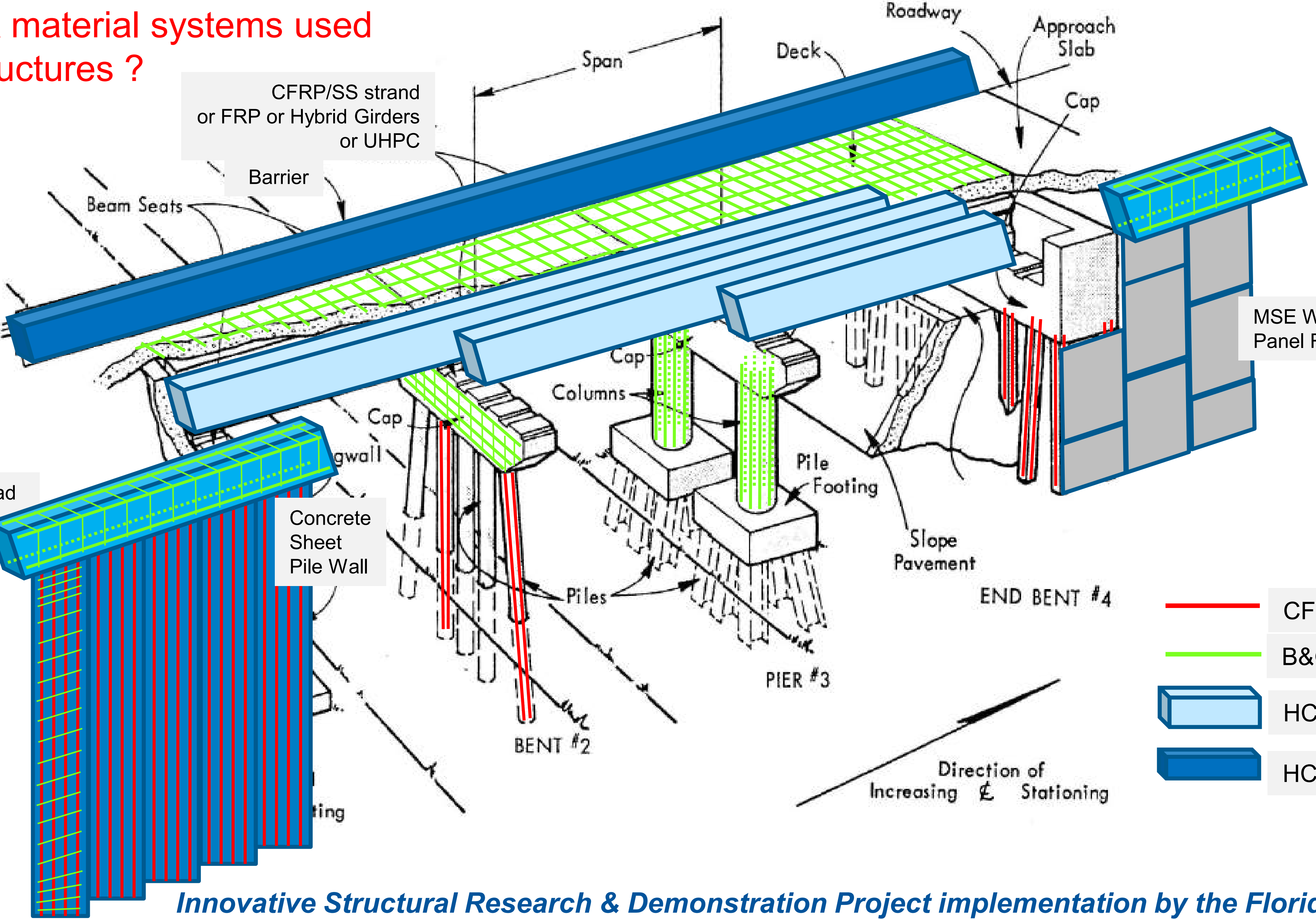
Ultra-High Performance Concrete (UHPC)

+ Stainless-Steel Prestressing Strand & Rebar

Innovative Structural Research & Demonstration Project implementation by the Florida DOT (2021)

Bridge Durability & Structural Advancement

Where are **HCR** material systems used in Bridges & Structures ?



CFRP/SS strand or FRP or Hybrid Girders or UHPC

Barrier

MSE Wall Panel Rebar

Bulkhead Cap

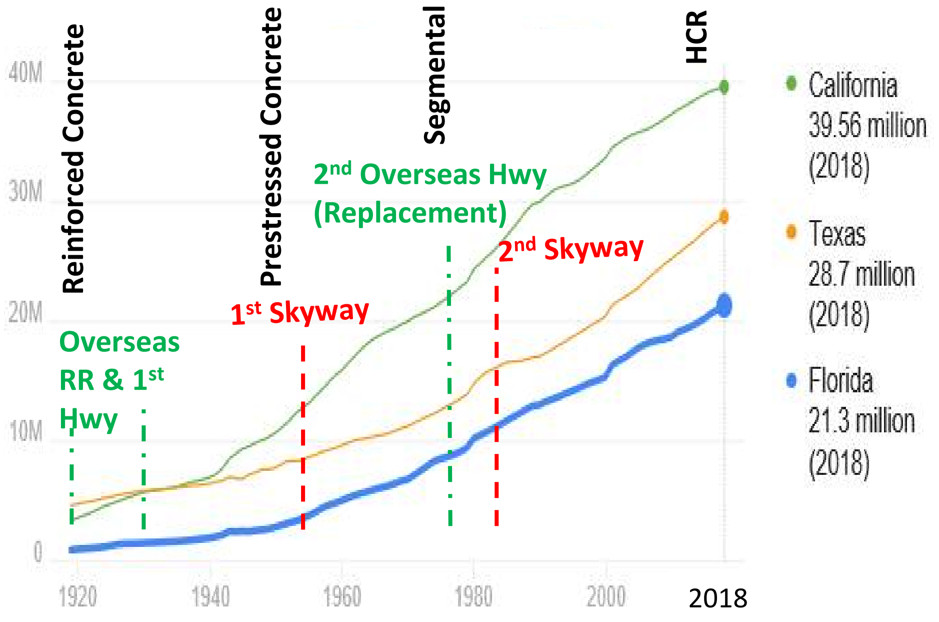
Concrete Sheet Pile Wall

- 🟥 CFRP or SS Strand
- 🟩 B&GFRP or SS Rebar
- HCR Bridge Girders
- HCR Traffic Barriers

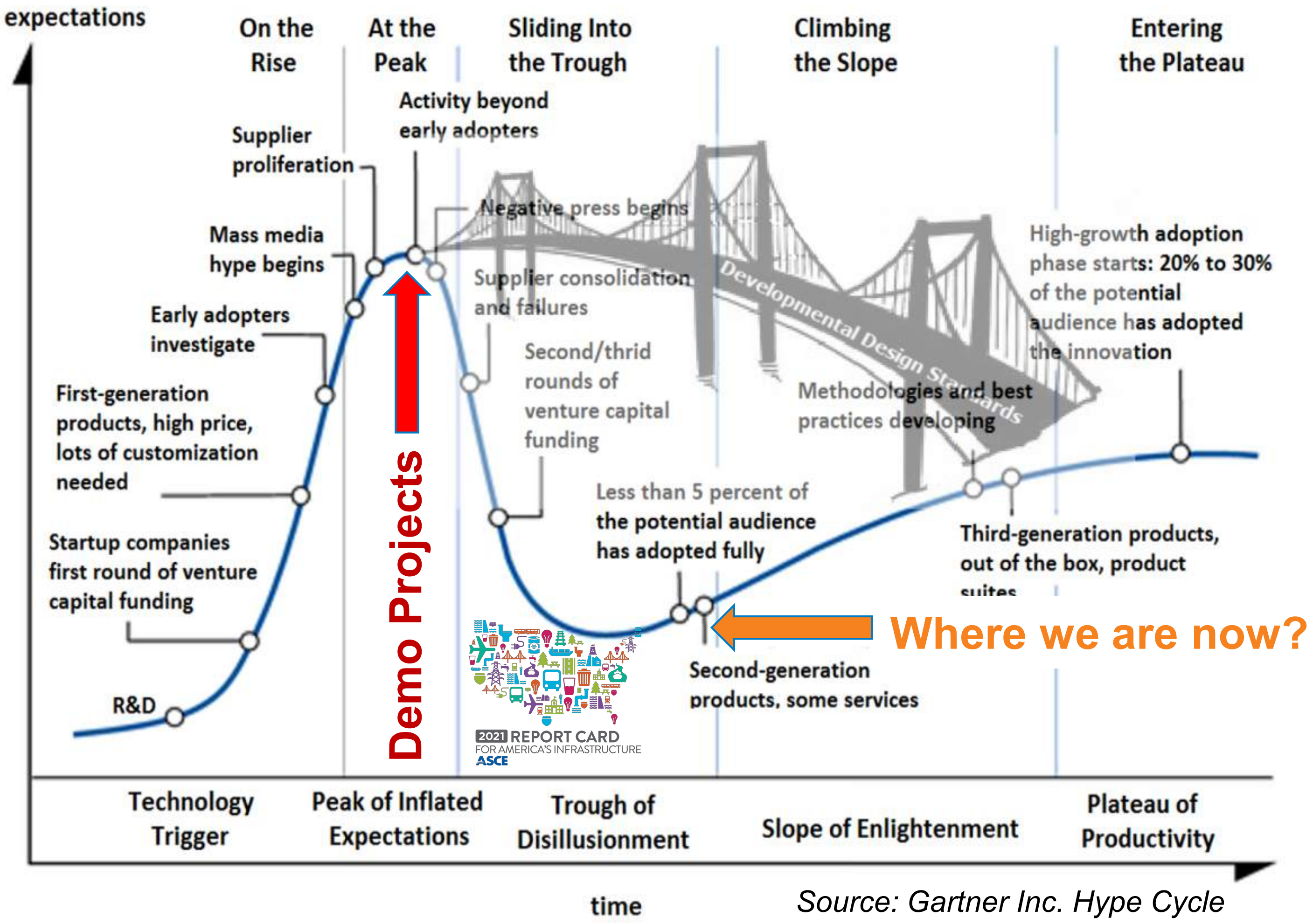
Innovative Structural Research & Demonstration Project implementation by the Florida DOT (2021)

How? Bridge Durability & Structural Advancement

- How do we bridge the gap between ***innovation*** and ***institutional adoption*** and keep up with our FTP needs?



FLORIDA POPULATION GROWTH

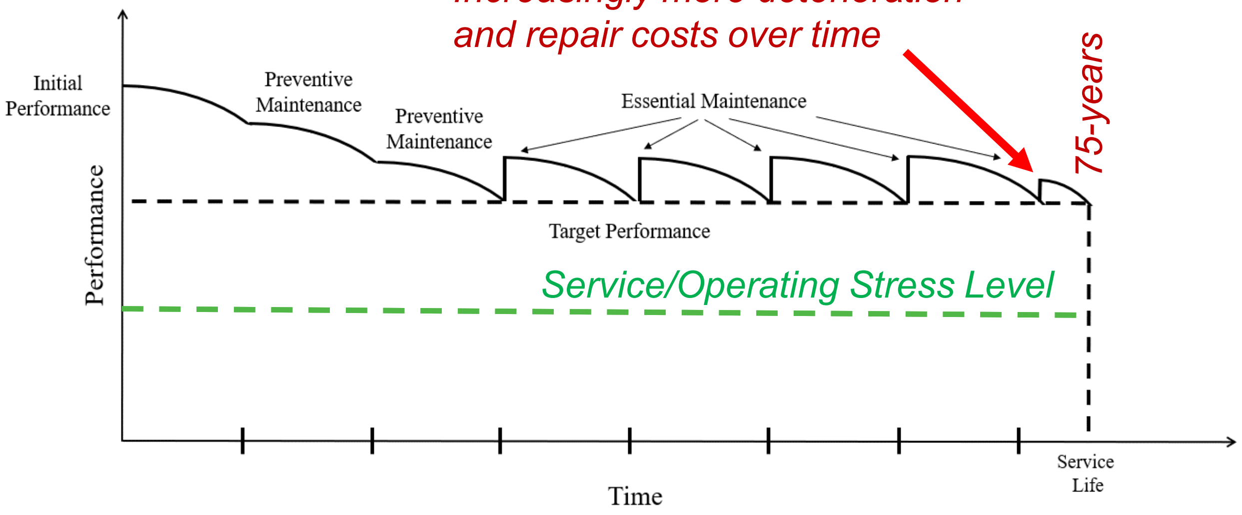


Source: Gartner Inc. Hype Cycle

Where does HCR technology lay on this chart for FDOT Bridge & Strutures?

Cost Justification (Life-Cycle Cost & Assessment)

LCC & LCA can show the sustainable (economic and environmental) advantage of composite structures in the coastal environment:

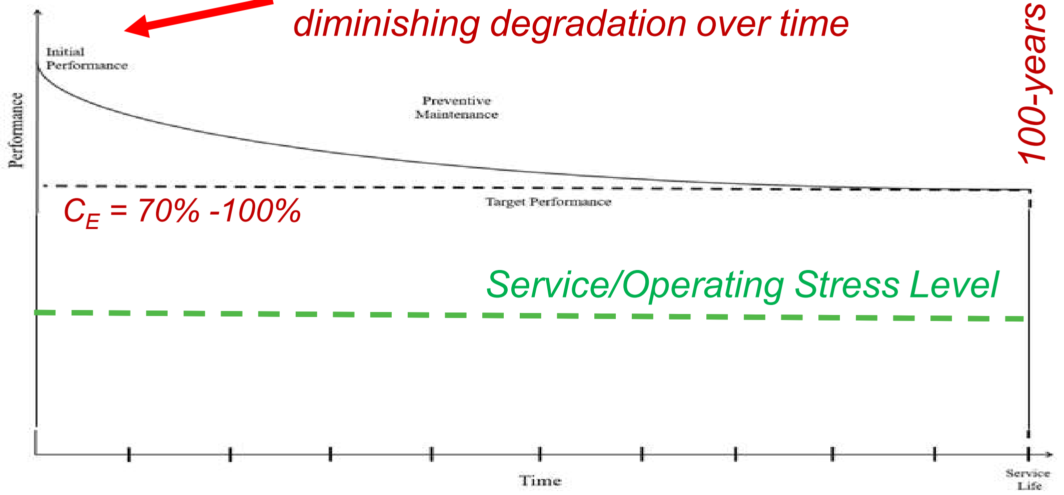


Increasingly more deterioration and repair costs over time

75-years

Service/Operating Stress Level

Current CS-RC/PC process



Over-strength design to accommodate diminishing degradation over time

100-years +

C_E = 70% -100%

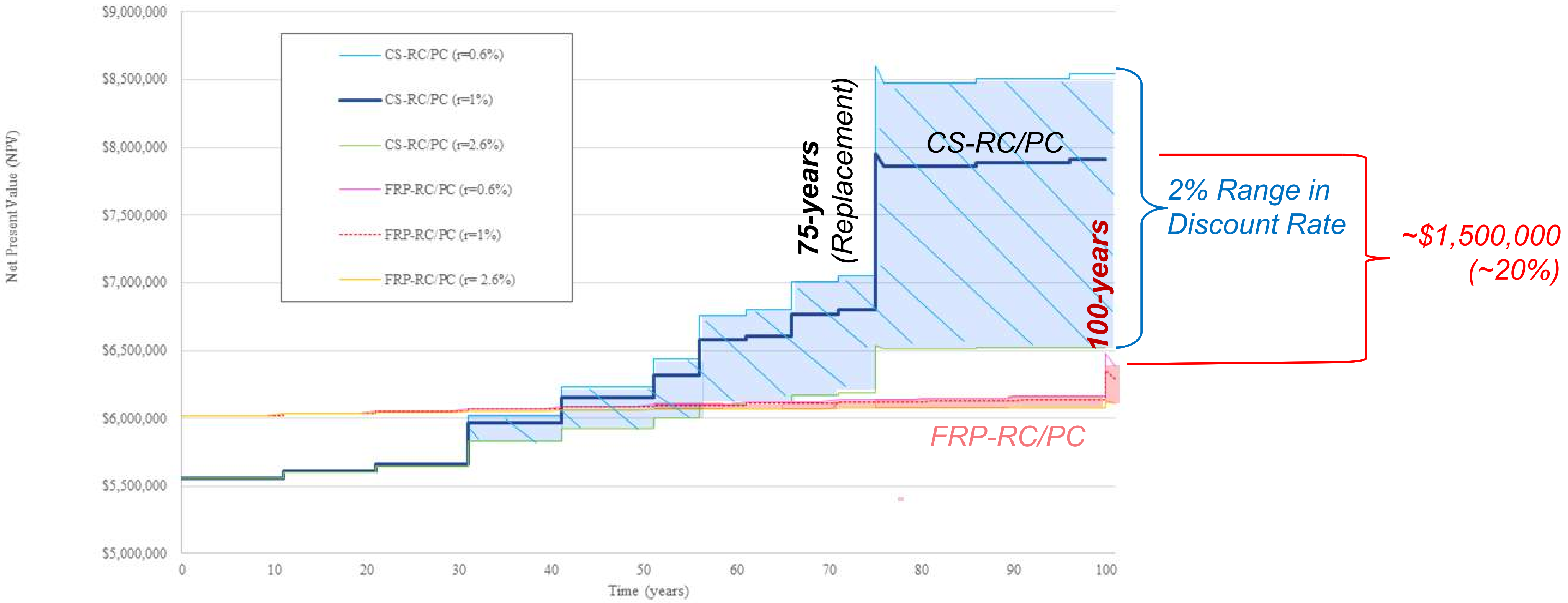
Service/Operating Stress Level

HCR-RC/PC alternative

Charts: Cadenazzi, T., Dotelli, G., Rossini, M., Nolan, S., and A. Nanni. (2019). Cost and Environmental Analyses of Reinforcement Alternatives for a Concrete Bridge. Structure and Infrastructure Engineering.

Cost Justification (Life-Cycle Cost Analysis)

Life-Cycle Cost (LCC) analysis can show the sustainable (economic) advantage of FRP structures in the coastal environment:



75-years
(Replacement)

100-years

2% Range in Discount Rate

~$1,500,000 (~20%)

Example LCC Comparison of Carbon Steel-RC/PC verses FRP-RC/PC bridge *(adapted from Cadenazzi et al. 2019)*

Innovative Structural Research & Demonstration Project implementation by the Florida DOT (2021)

Implementing Technology for Longer-Lasting Bridges & Structures

How do we encourage more Local Agency & District innovation participation?

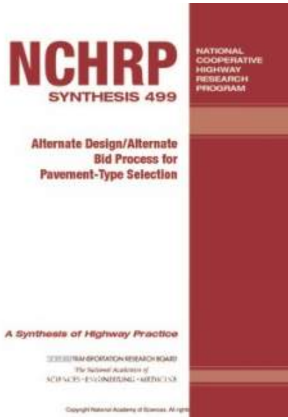
1. **Schedule** is always a challenge – *seems its always "too early" or "too late".*
2. **Construction** is not the ideal time to propose innovative material alternates, but often that is what industry must default too thru the CSI process – *engineering cost and schedule risk is passed on to the contractor.*
3. **Implementation** at the beginning of the consultant's Design Contract is too slow → 3-*6 years before construction complete.*

→ *Need a more* ***nimble*** *and* ***equitable*** *process!*

Implementing Technology for Longer-Lasting Bridges & Structures

What could a more nimble and equitable process look like?

- **Nimble** – *encourage alternate designs post-BDR & during procurement of contractor.*
- **Equitable** – *(1) Pay for the design of recognized innovative alternates upfront (**Design-Innovation**) in addition to conventional design (~ADAB) = "Low-Bid" (A);*
  - *(2) Bid alternates recognize the life-cycle cost benefits = "Best Value Bid" (A+D)*
- **Incentivize** – *For "Cost Savings Initiatives" (CSI ~VE) proposals using select higher-performing materials (eg. **Design-Innovation**)→ Give up DOT portion of savings – no sharing.*
- **Empower other Stakeholders** – *cost adjustment and schedule extensions until institutionalized.*



NCHRP

SYNTHESIS 499

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Alternate Design/Alternate Bid Process for Pavement-Type Selection

A Synthesis of Highway Practice

Implementing Technology for Longer-Lasting Bridges & Structures

Negative effects of a more nimble and equitable process?

- **Nimble** – *mistakes due to new procedures & doing more with the same or less?*
- **Equitable** – *cost & time increase for design and/or construction.*

- **Incentives** – *less cost sharing with the Department.*

- **Empowering other Stakeholders** – *loss of owner control.*

Implementing Technology for Longer-Lasting Bridges & Structures

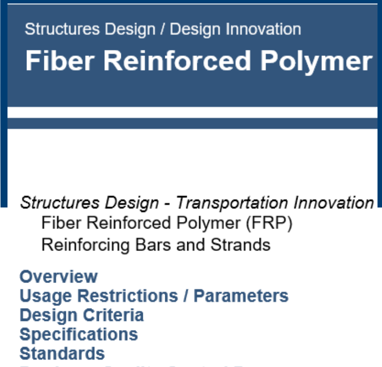
Positive outcomes of a more nimble and equitable process?

- **Nimble** – *more responsive to innovation and scalable deployment,*
  – can bring new business to the State if the market is seen as more open than other places.
- **Equitable** – *all solutions are evaluated based on value.*

- **Incentives** – *makes the DOT look more progressive to industry & public & can develops new industries!*
- **Empowering other Stakeholders** – *more buy-in or "ownership" of the implementation challenges by others.*

Project Fast-Facts

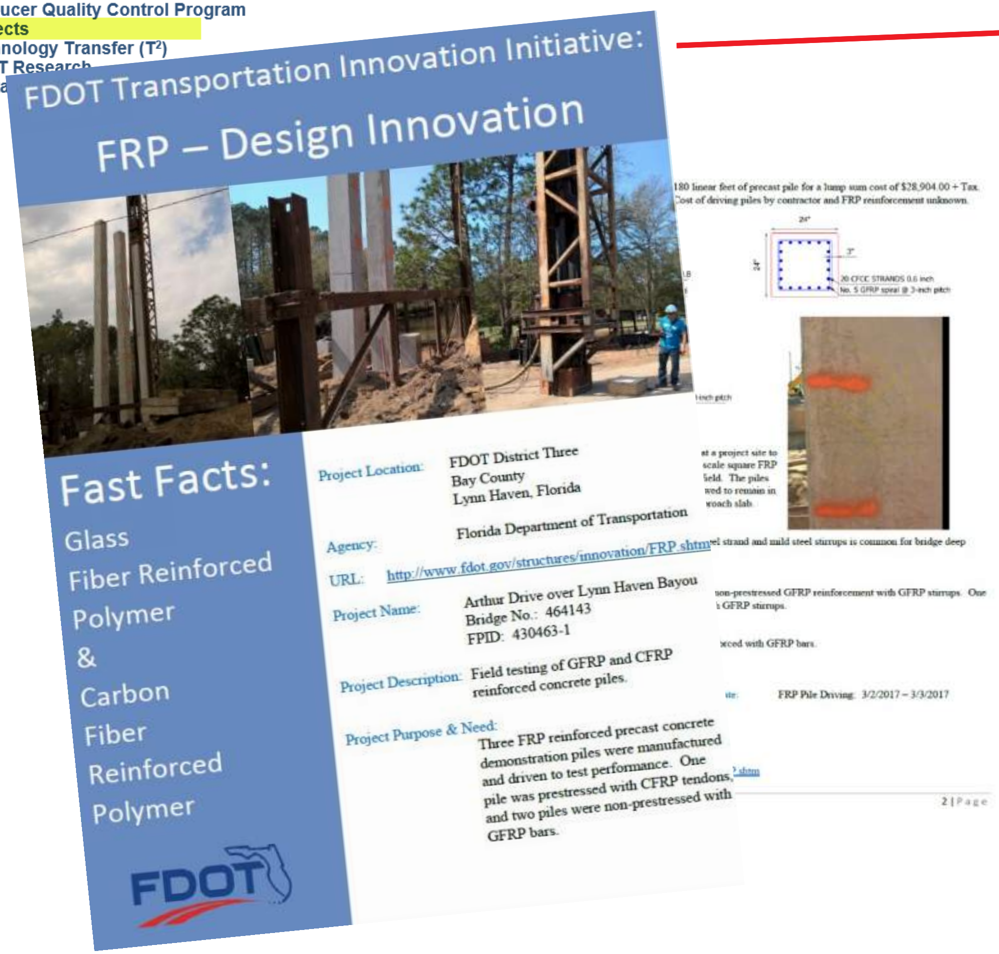
Fast-Facts:
https://www.fdot.gov/structures/innovation/FRP.shtm#link9



Structures Design / Design Innovation
Fiber Reinforced Polymer

Structures Design - Transportation Innovation
Fiber Reinforced Polymer (FRP)
Reinforcing Bars and Strands

- **Overview**
- **Usage Restrictions / Parameters**
- **Design Criteria**
- **Specifications**
- **Standards**
- **Producer Quality Control Program**
- **Projects**
- **Technology Transfer (T^2)**
- **FDOT Research**
- **Conta**



FDOT Transportation Innovation Initiative:
FRP – Design Innovation

Fast Facts:
Glass Fiber Reinforced Polymer & Carbon Fiber Reinforced Polymer

Project Location:	FDOT District Three Bay County Lynn Haven, Florida
Agency:	Florida Department of Transportation
URL:	http://www.fdot.gov/structures/innovation/FRP.shtm
Project Name:	Arthur Drive over Lynn Haven Bayou Bridge No.: 464143 FPID: 430463-1
Project Description:	Field testing of GFRP and CFRP reinforced concrete piles.
Project Purpose & Need:	Three FRP reinforced precast concrete demonstration piles were manufactured and driven to test performance. One pile was prestressed with CFRP tendons, and two piles were non-prestressed with GFRP bars.

180 linear feet of precast pile for a lump sum cost of $28,904.00 + Tax. Cost of driving piles by contractor and FRP reinforcement unknown.

at a project site to … scale square FRP … field. The piles … wed to remain in … roach slab.

…el strand and mild steel stirrups is common for bridge deep

…non-prestressed GFRP reinforcement with GFRP stirrups. One … GFRP stirrups.

…rced with GFRP bars.

FRP Pile Driving: 3/2/2017 – 3/3/2017

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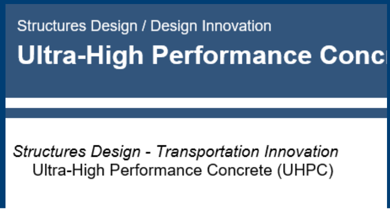
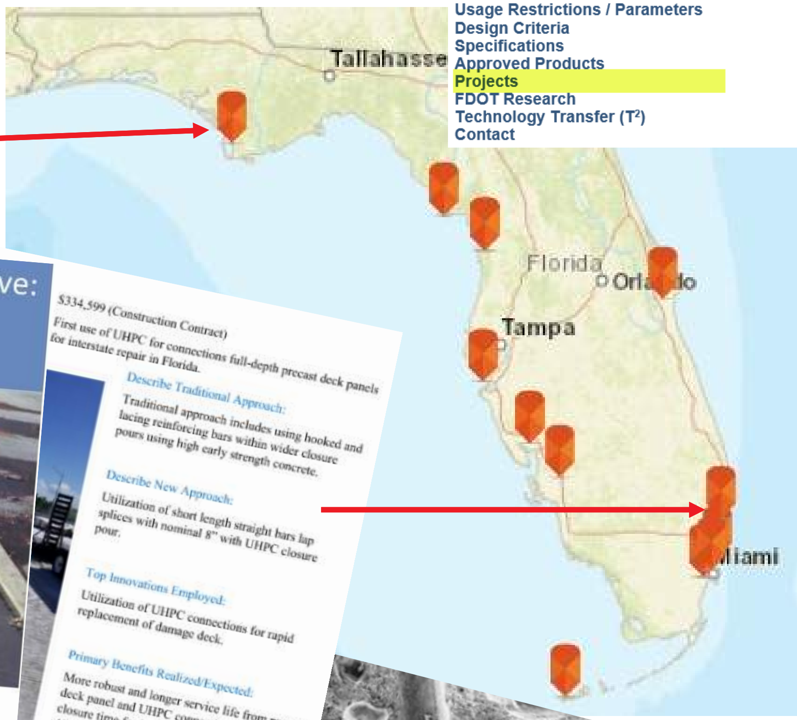
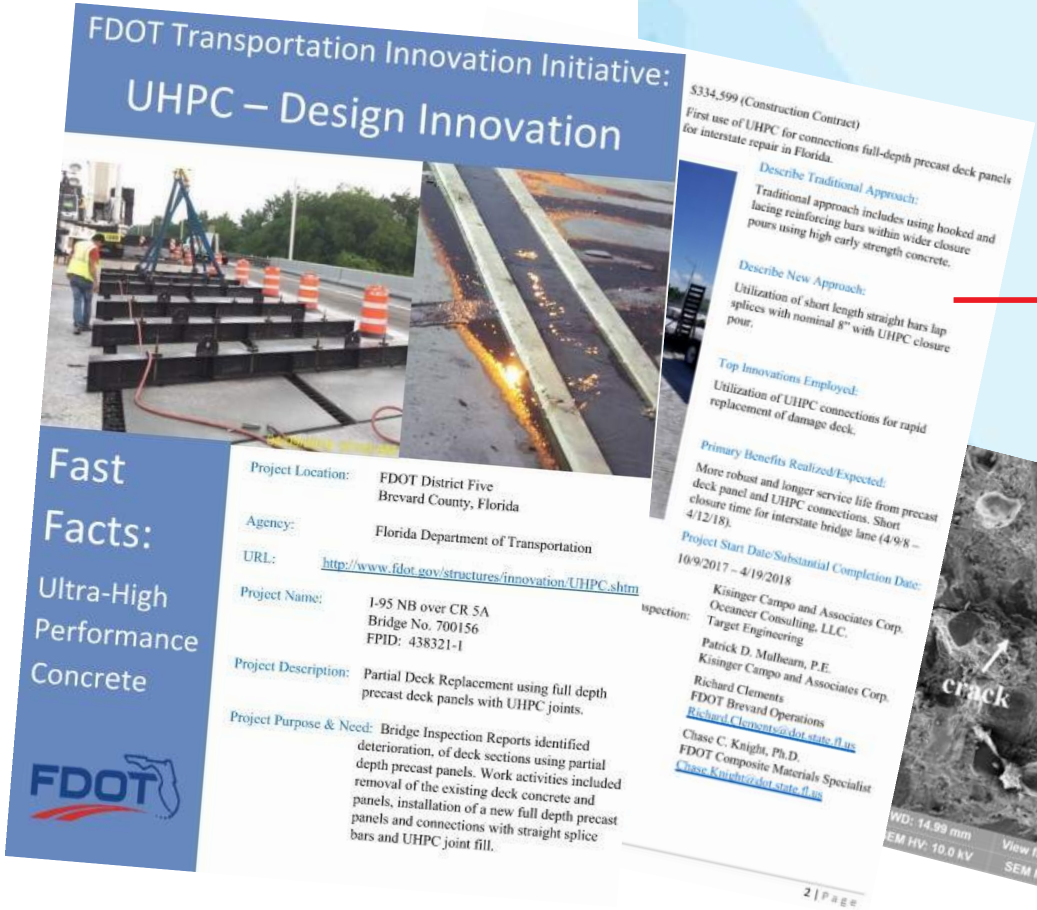


Structures Design / Design Innovation
Ultra-High Performance Conc

Structures Design - Transportation Innovation
Ultra-High Performance Concrete (UHPC)

- **Overview**
- **Usage Restrictions / Parameters**
- **Design Criteria**
- **Specifications**
- **Approved Products**
- **Projects**
- **FDOT Research**
- **Technology Transfer (T^2)**
- **Contact**





FDOT Transportation Innovation Initiative:
UHPC – Design Innovation

Fast Facts:
Ultra-High Performance Concrete

Project Location:	FDOT District Five Brevard County, Florida
Agency:	Florida Department of Transportation
URL:	http://www.fdot.gov/structures/innovation/UHPC.shtm
Project Name:	I-95 NB over CR 5A Bridge No. 700156 FPID: 438321-1
Project Description:	Partial Deck Replacement using full depth precast deck panels with UHPC joints.
Project Purpose & Need:	Bridge Inspection Reports identified deterioration, of deck sections using partial depth precast panels. Work activities included removal of the existing deck concrete and panels, installation of a new full depth precast panels and connections with straight splice bars and UHPC joint fill.

$334,599 (Construction Contract)
First use of UHPC for connections full-depth precast deck panels for interstate repair in Florida.

Describe Traditional Approach:
Traditional approach includes using hooked and lacing reinforcing bars within wider closure pours using high early strength concrete.

Describe New Approach:
Utilization of short length straight bars lap splices with nominal 8" with UHPC closure pour.

Top Innovations Employed:
Utilization of UHPC connections for rapid replacement of damage deck.

Primary Benefits Realized/Expected:
More robust and longer service life from precast deck panel and UHPC connections. Short closure time for interstate bridge lane (4/9/8 – 4/12/18).

Project Start Date/Substantial Completion Date:
10/9/2017 – 4/19/2018

…spection: Kisinger Campo and Associates Corp.
Oceaneer Consulting, LLC.
Target Engineering

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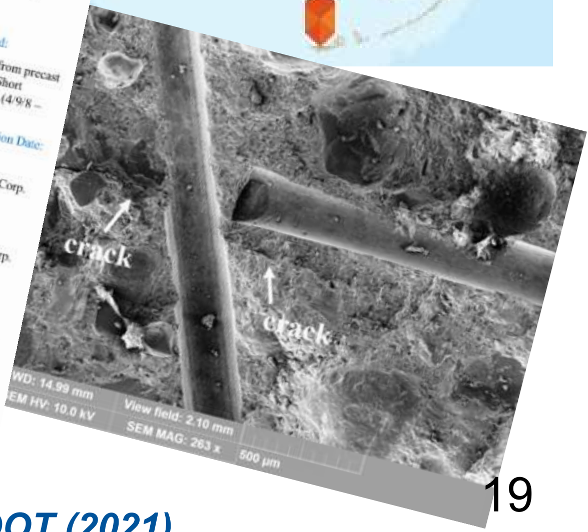

Structures Design / Design Innovation

Fiber Reinforced Polymer

Structures Design - Transportation Innovation

Fiber Reinforced Polymer (FRP)

Reinforcing Bars and Strands

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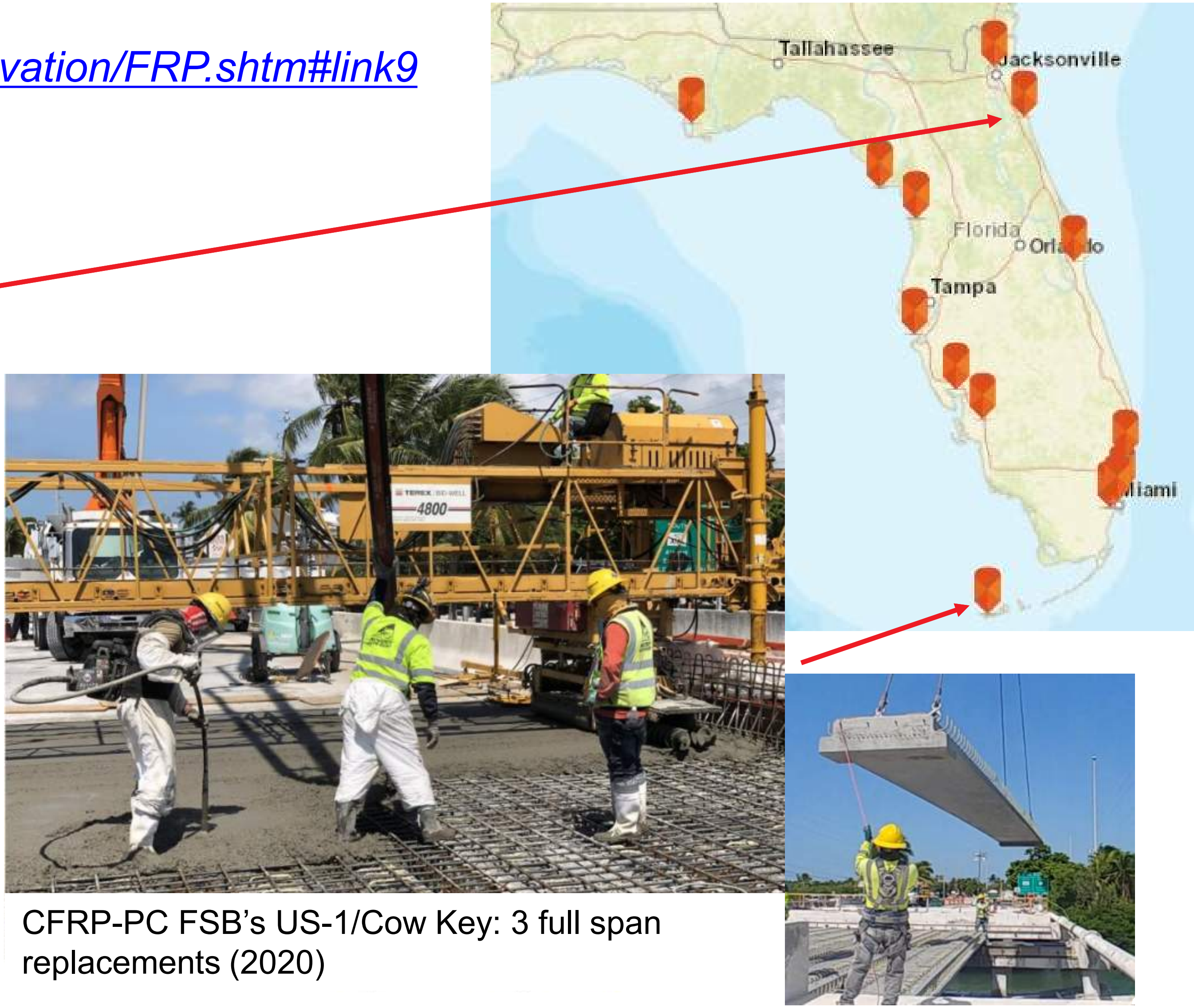
Project Fast-Facts

Fast-Facts:

https://www.fdot.gov/structures/innovation/FRP.shtm#link9

GFRP Secant-Pile Shaft cages for A1A-Flagler Beach seawall (2019)

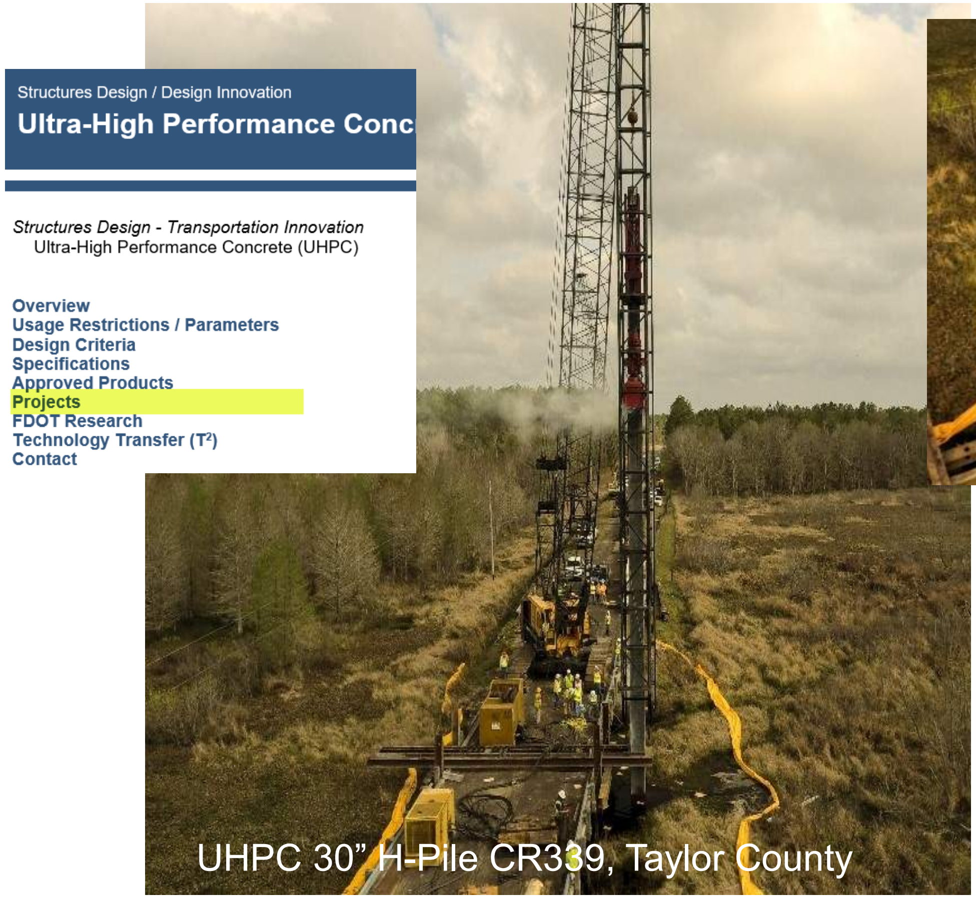


CFRP-PC FSB's US-1/Cow Key: 3 full span replacements (2020)

Innovative Structural Research & Demonstration Project implementation by the Florida DOT (2021)

Project Fast-Facts

Fast-Facts: *https://www.fdot.gov/structures/innovation/FRP.shtm#link9*



Structures Design / Design Innovation

Ultra-High Performance Conc

Structures Design - Transportation Innovation
Ultra-High Performance Concrete (UHPC)

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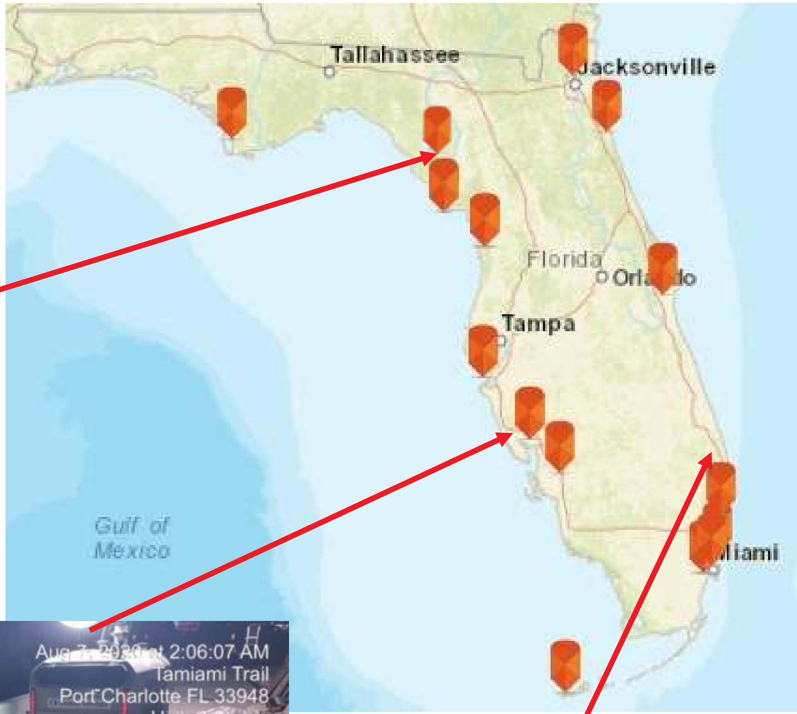
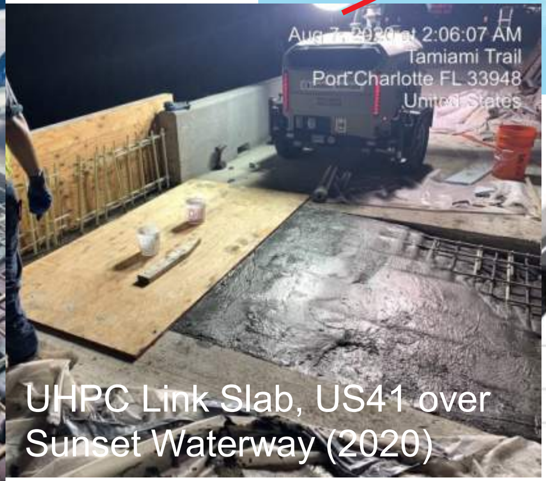
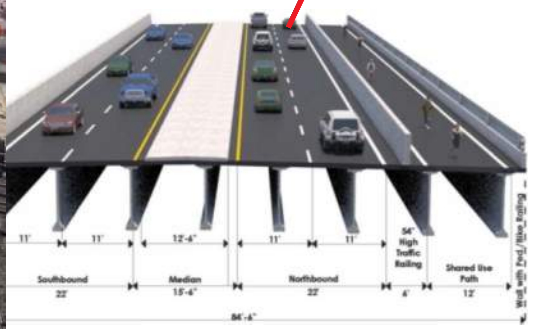
UHPC 30" H-Pile CR339, Taylor County





UHPC Link Slab, US41 over Sunset Waterway (2020)



250' simple span pending?

Questions

The Grades are in:

- ***C-*** *(Infrastructure)*

Missouri:
24,494 bridges, 8.8% of which were structurally deficient in 2019

Bridge Conditions by Year