2017 FDOT – Halls River Bridge FRP Workshop

May 3, 2017

Tampa, FL

HRB-FRP Workshop (Part 3)

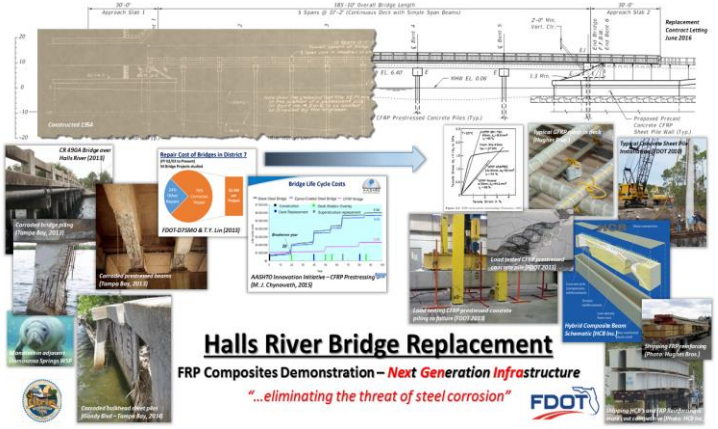
Presenter: **Michelle Roddenberry, PhD, P.E.**

Principal Investigator

FAMU-FSU College of Engineering

Collaborator: **Antonio Nanni, PhD, P.E.**

University of Miami



Outline:

Part 1 – Bridge Design

1. Halls River Bridge Project Overview - (Suarez/Pelham)
2. Hybrid Composite Beams - (Masseus/Siddiqui/Hillman)
3. GFRP-RC Deck Design - (Siddiqui/Nanni)
4. GFRP-RC Bent Cap Design - (Elisha/ Siddiqui/Pelham)
5. GFRP-RC End Bents, Back Wall & Wing Walls - (Siddiqui)

(15 min. break)

Part 2 - Developmental Standards:

5. CFRP Prestressed Bearing Piles - (Nolan)
6. Cantilever Sheet Pile Walls (Bulkhead/Seawall) - (Nolan/Hunter)
7. Gravity Walls - (Nolan)
8. GFRP-RC Traffic Railings & Approach Slabs - (Nolan)

Part 3 - Research Project & Monitoring - (Knight/Roddenberry)

Part 4 - CEI's Insights and Recommendations - (D7 Construction)

Part 5 - Open Discussion

Research Project & Monitoring

Objectives

- Verify the ability of experimental features within an extremely aggressive environment to increase the overall life of the bridge along with decreasing the associated maintenance costs
- Prove validity of experimental features for future use of these products

Main Tasks

- Observe and document the fabrication activities
- Document the construction activities
- Document the quality of the constructed bridge

Main Tasks

- Measure the performance of the in-service bridge by monitoring and durability testing
- Identify and quantify material degradation of concrete and FRP in sheet pile wall caps
  - End of construction
  - 6 months
  - 1 year
  - 2 years

Main Tasks

For concrete:

- Concrete compressive strength (ASTM C42)*
- Penetration of chloride ion into concrete (ASTM C1202 / AASHTO T277)*
- pH*
- Stiffness*
- Elemental analysis via Energy Dispersive X-ray (EDX)
- Fourier Transform Infrared (FTIR) spectroscopy*

Main Tasks

For FRP:

- Transverse shear strength (ASTM D7617)
- Horizontal shear strength (ASTM D4475)
- Fiber content (ASTM D2584)*
- Glass transition temperature by Dynamic Mechanical Analysis (DMA) (ASTM E1640)
- Tensile strength (ASTM D7205)
- Maximum outside dimensions (ASTM D792)
- Moisture absorption (ASTM D570)*
- Degree of cure by differential scanning calorimetry (DSC) (ASTM E2160)*
- Scanning electron microscope (SEM) image analysis at the inner core, the outer core, and the concrete-rebar bond interface
- Elemental analysis via Energy Dispersive X-ray (EDX)
- Fourier Transform Infrared (FTIR) spectroscopy*

CFCC Pile Driving

Halls River Bridge
Homosassa Springs, FL


BUCKNER
HEAVYLIFT CRANES

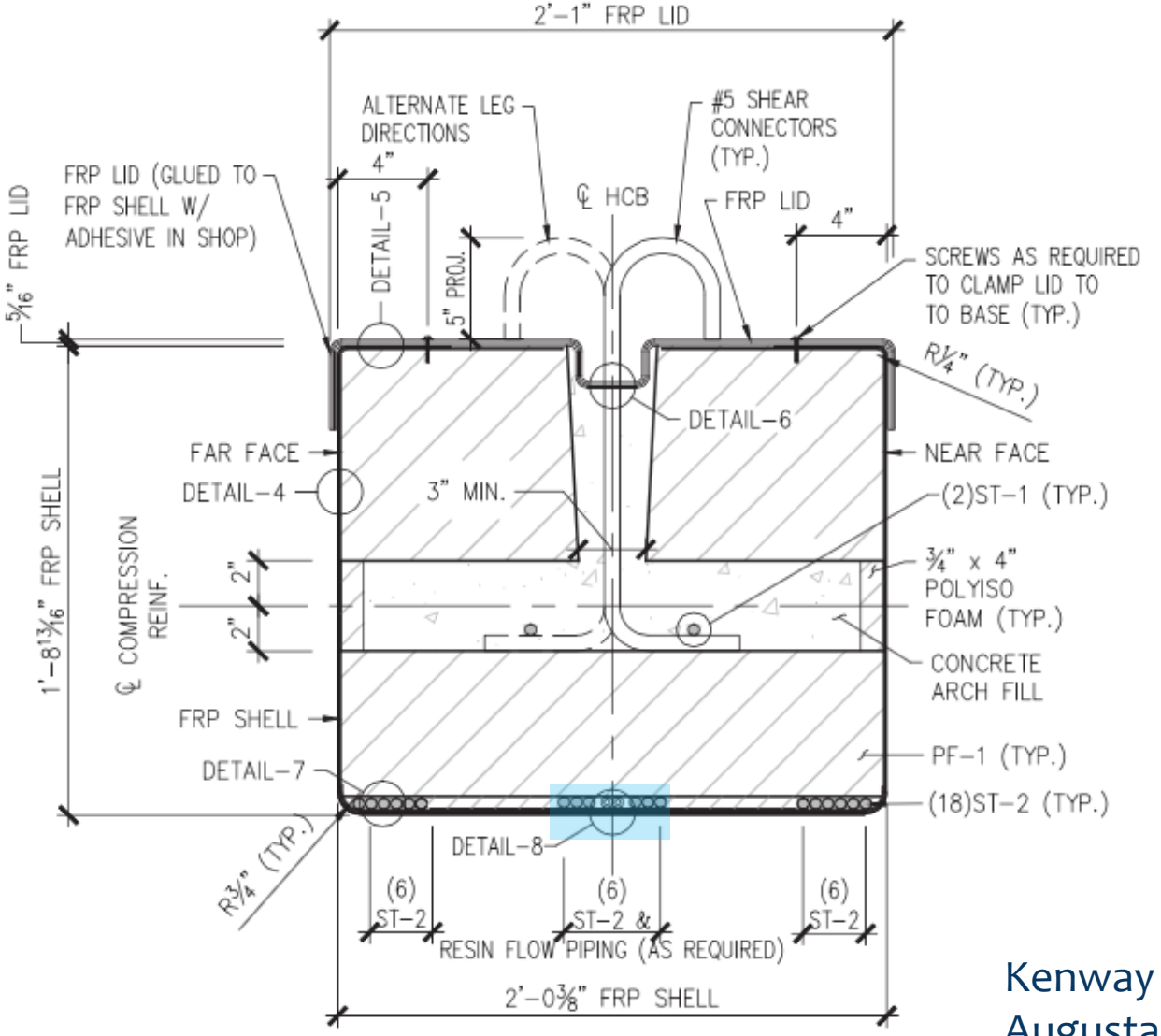

45
40

CFCC/GFRP Prestressed Sheet Piles

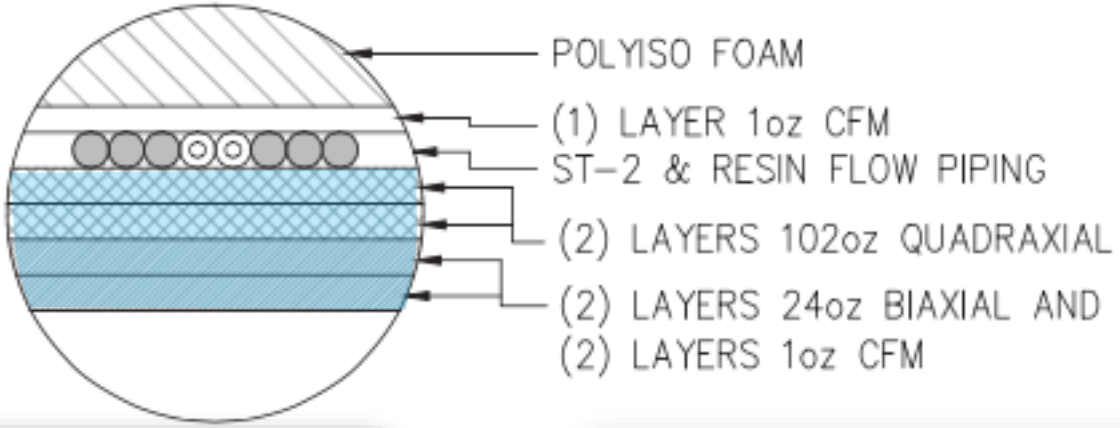
bany
Jacksonville, FL

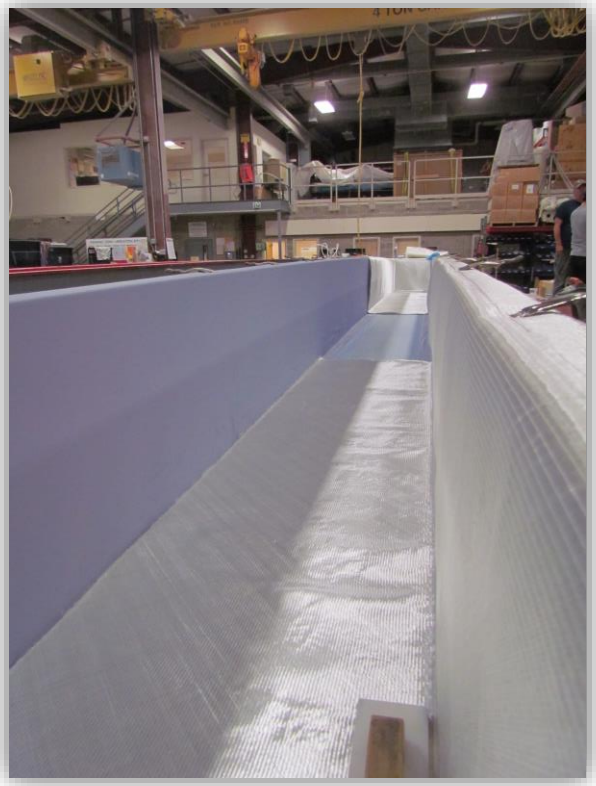

MI-JACK
TRAVELIFT
JCB

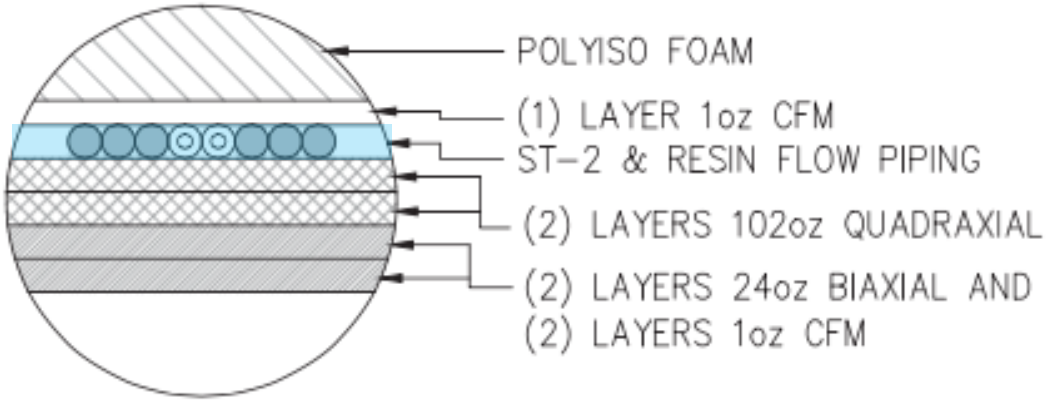
Hybrid Composite Beam (HCB)



Kenway Corporation
Augusta, ME


POLYISO FOAM
(1) LAYER 1oz CFM
ST-2 & RESIN FLOW PIPING
(2) LAYERS 102oz QUADRAXIAL
(2) LAYERS 24oz BIAXIAL AND
(2) LAYERS 1oz CFM

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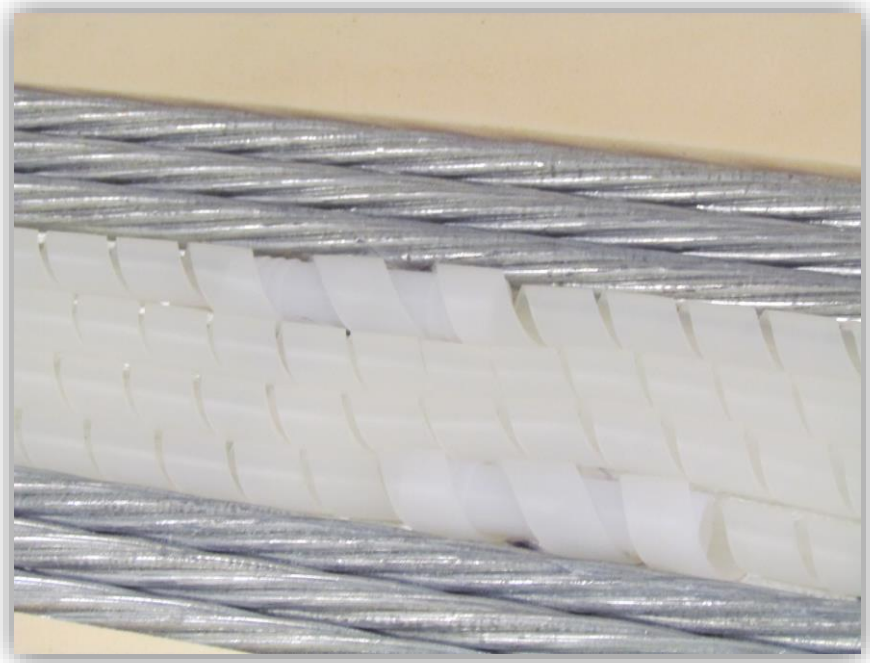

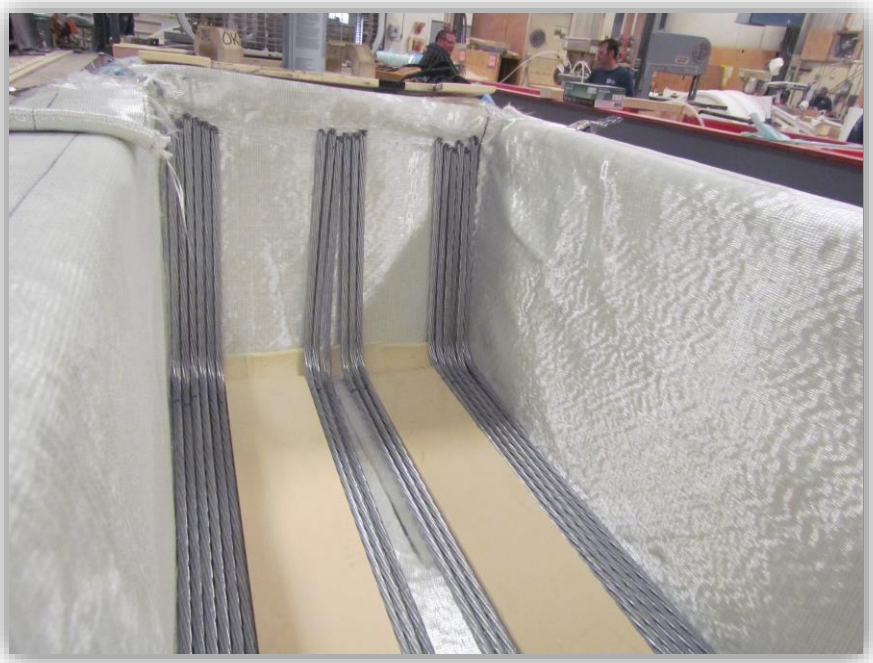

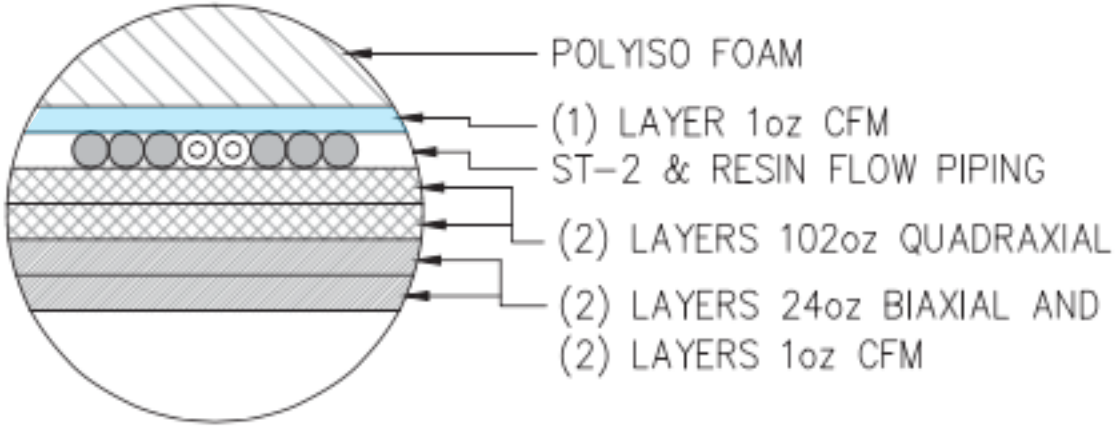
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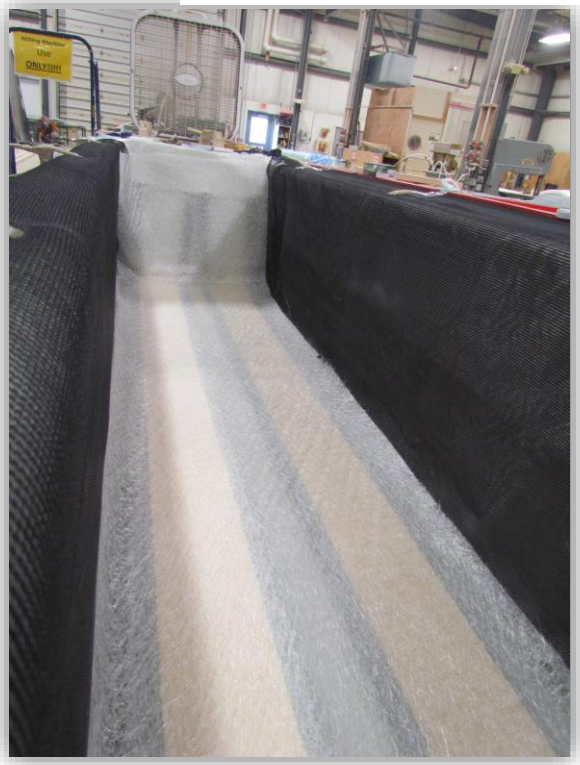

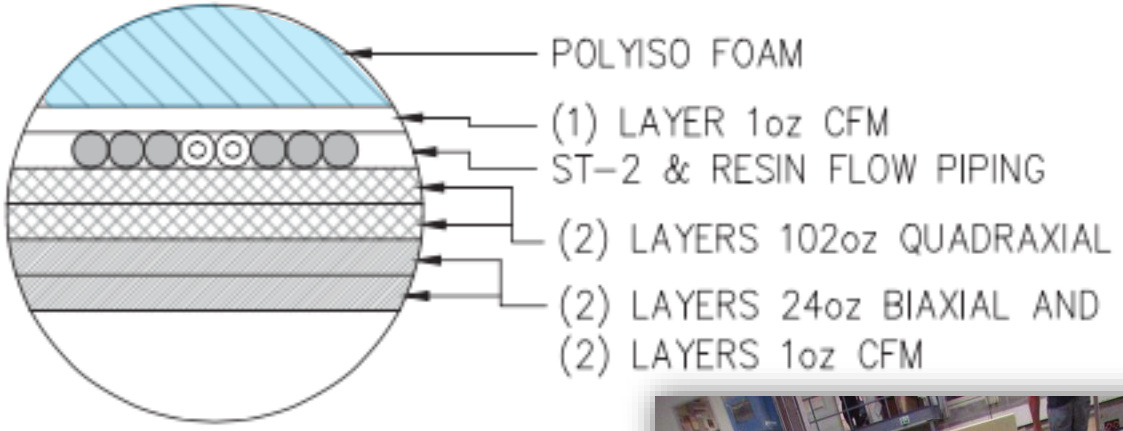
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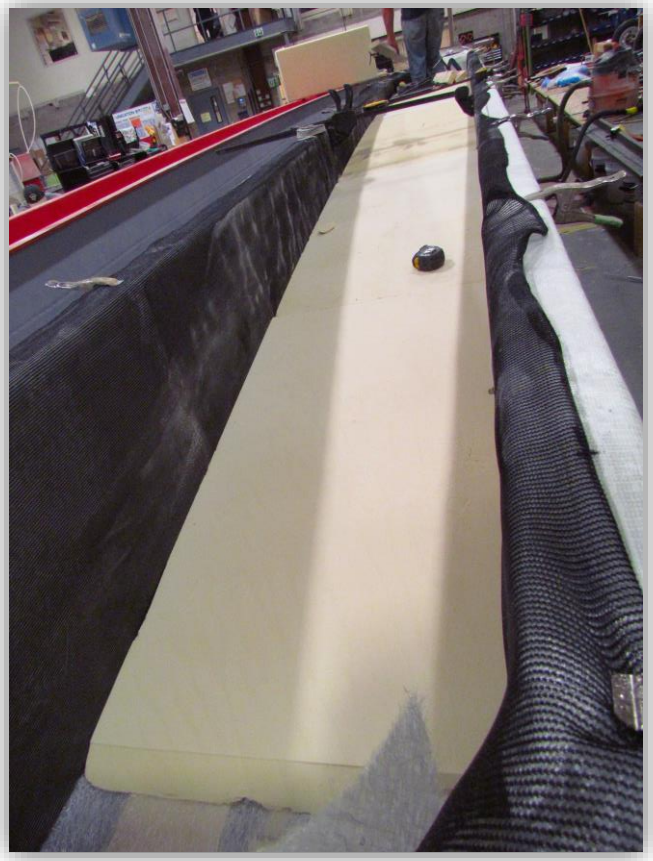
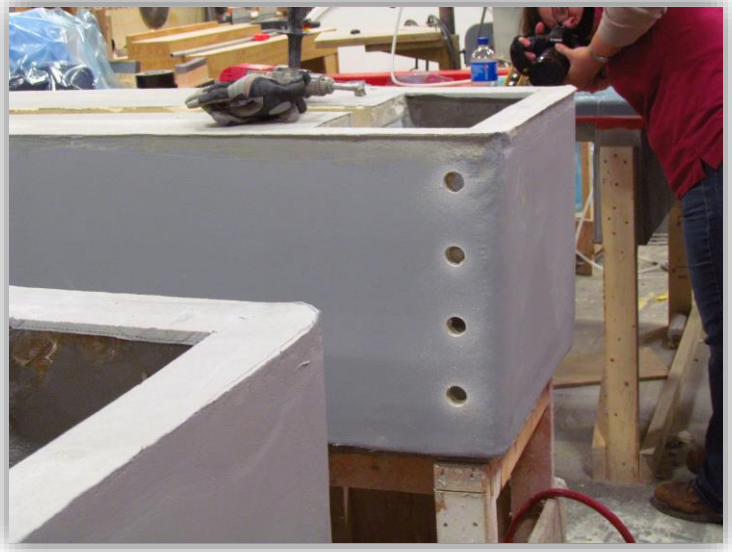


Lid Resin Infusion & Preparation

Shell Resin Infusion

Shell Preparation

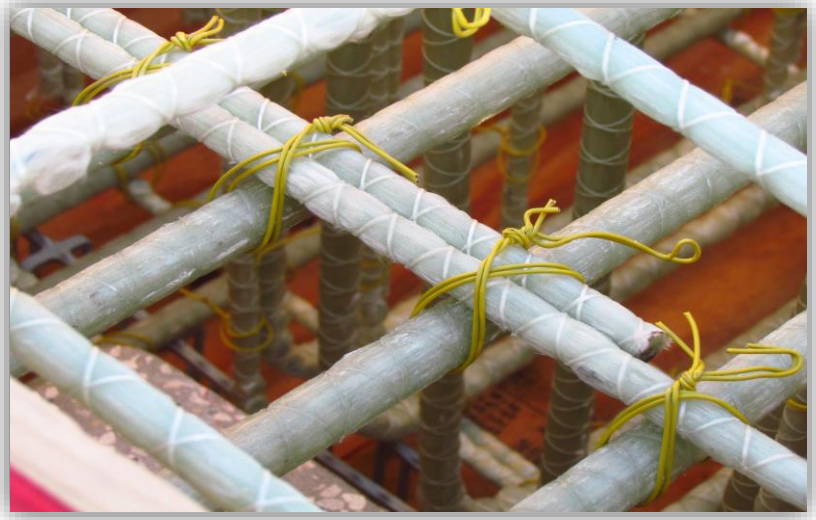


Reinforcement

Concrete Arch Casting

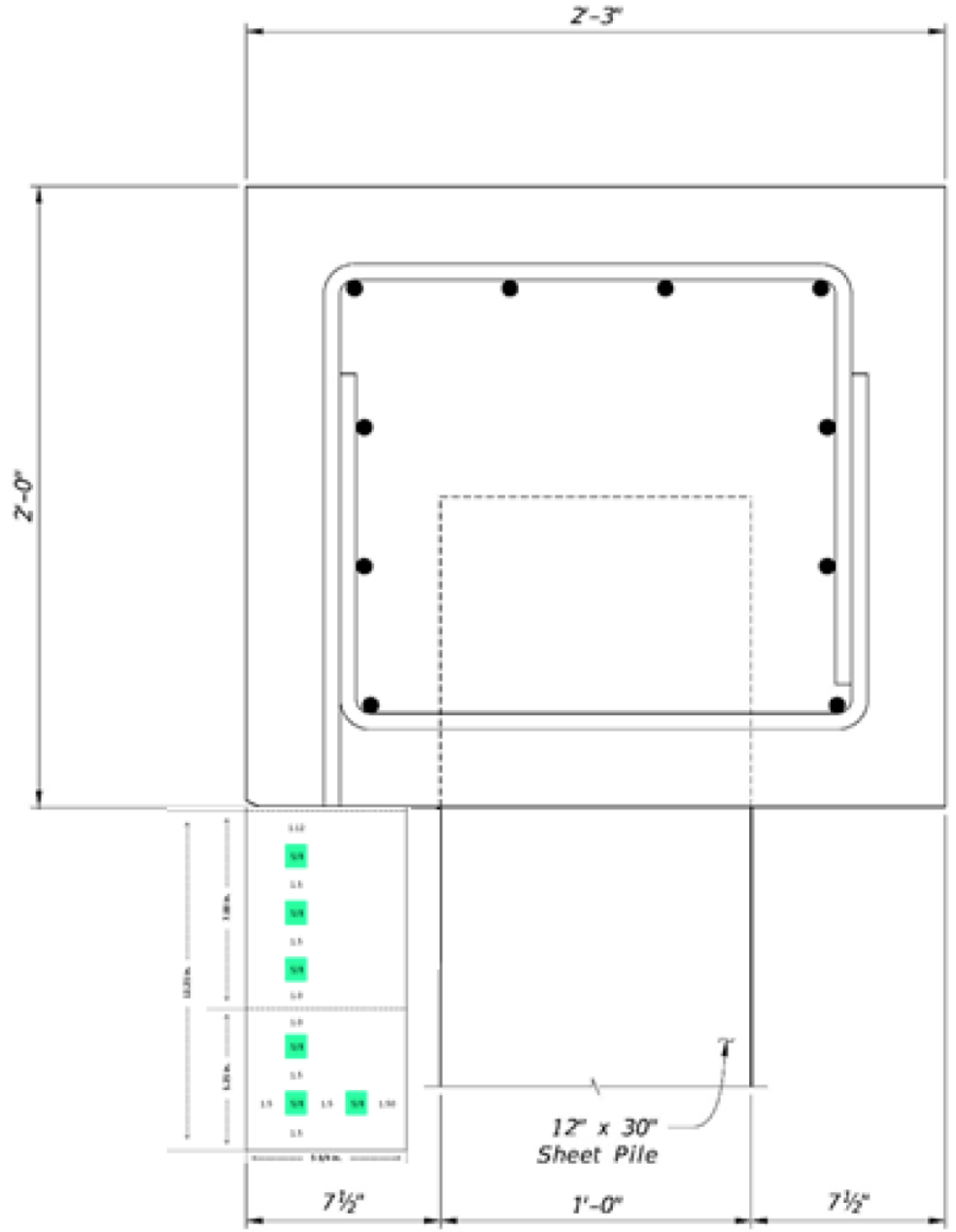
CDS Manufacturing Inc.
Gretna, FL

GFRP Reinforced Bent Caps




WACKER
NEUSON

Sheet Pile Test Blocks

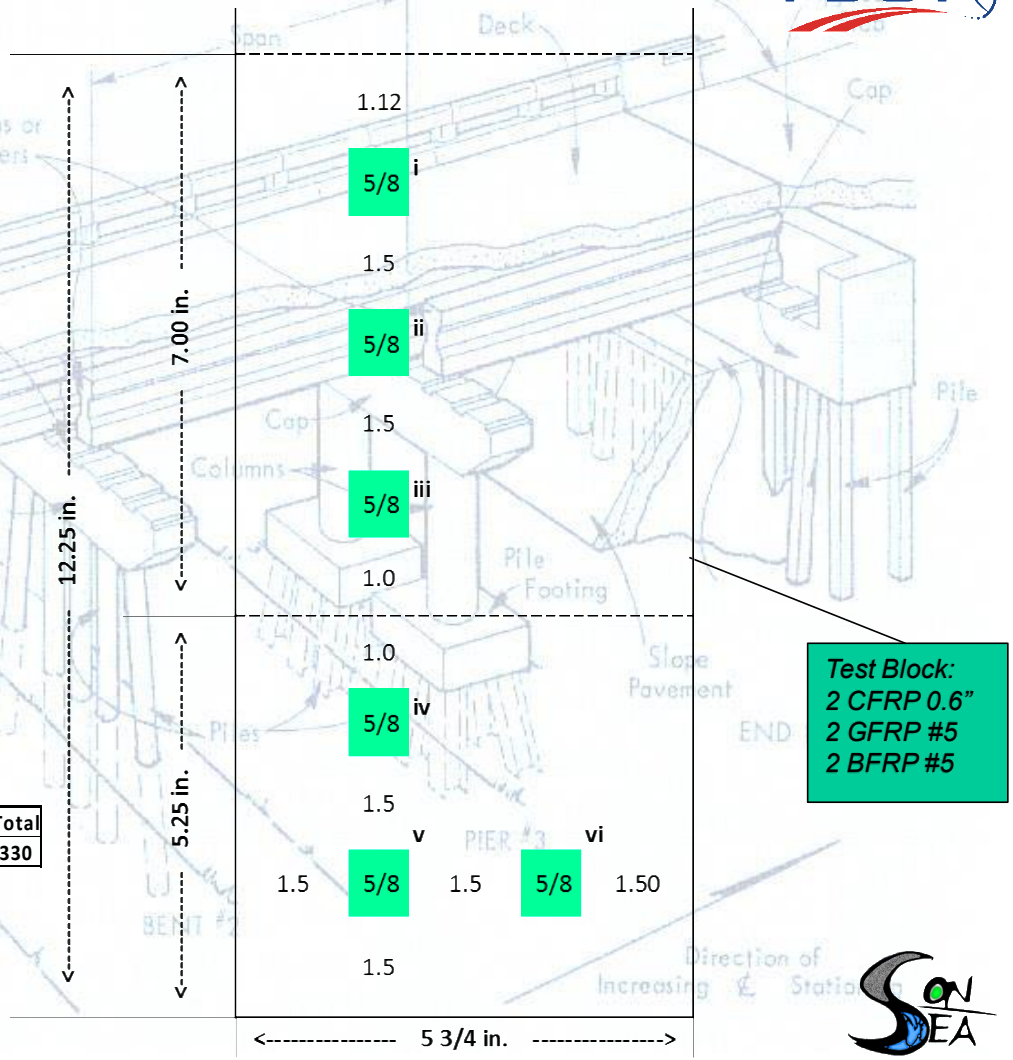


FRP-RC Test blocks (with CFRP, GFRP & BFRP)

New FRP rebar configuration

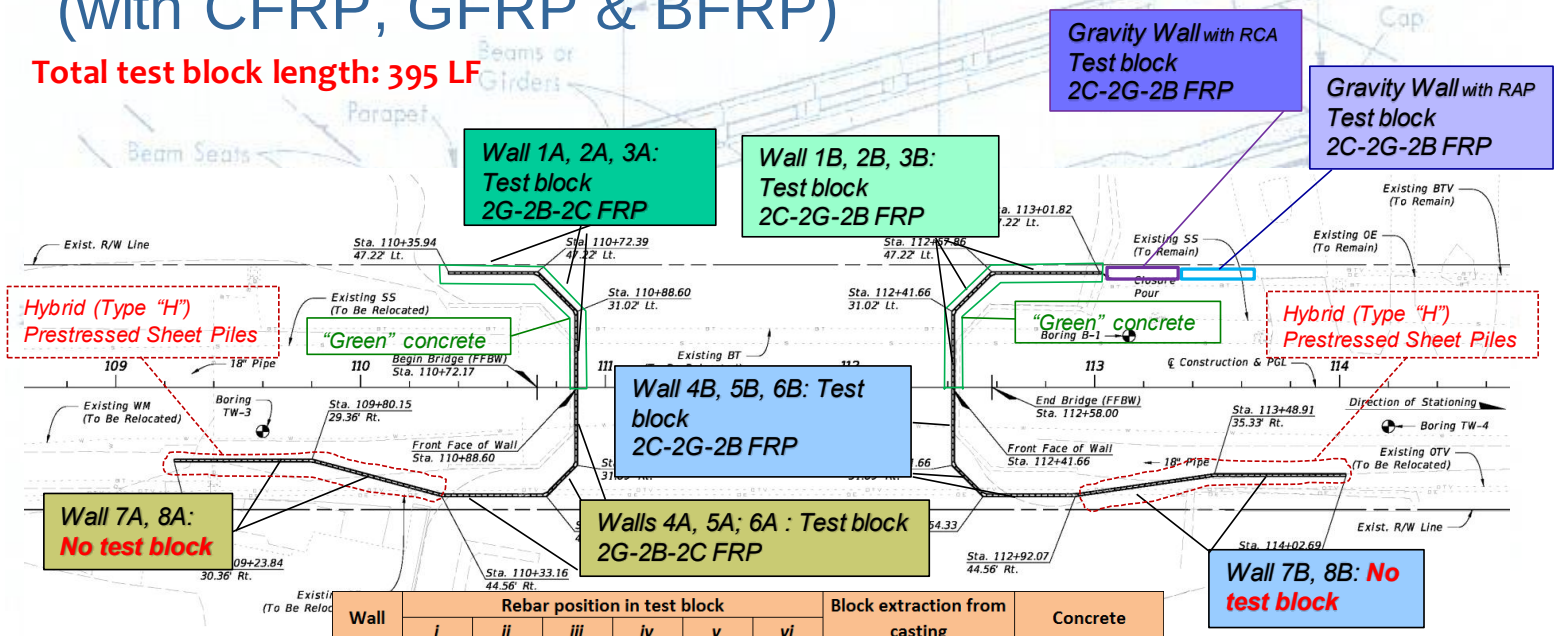
Bottom			Top			
	in.	ft		in.	ft	
h	5.25	0.44	h	7.00	0.58	
w	5.75	0.48	w	5.75	0.48	
L		5.00	L		5.00	
Volume, ft3		1.05			1.40	
Gama, lbs/ft3		135			135	Total
Weight, lbs		**142**			**189**	**330**

Rebar disposition with 1.5" concrete cover and 1.5" clear spacing in test block divided in two pieces for ease of extraction



FRP-RC Test blocks
(with CFRP, GFRP & BFRP)

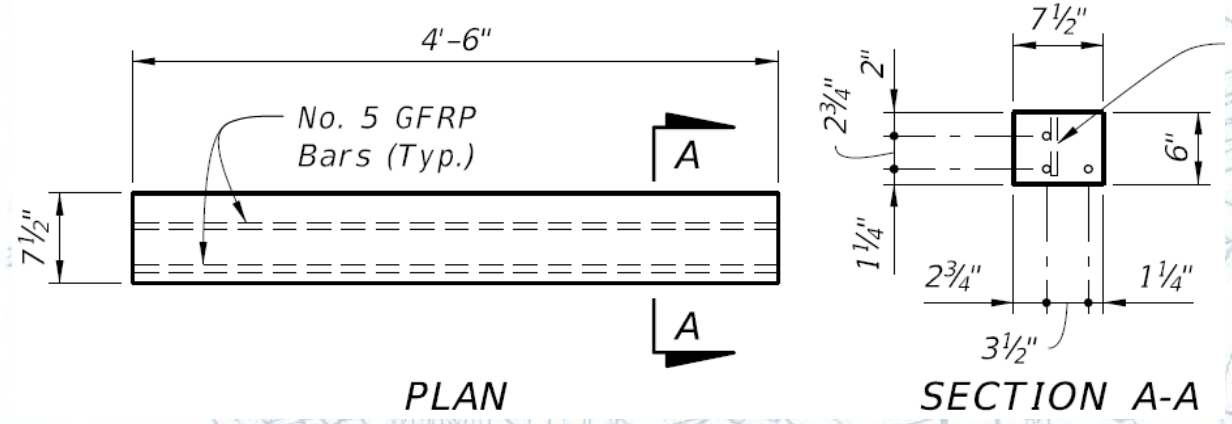
Total test block length: 395 LF



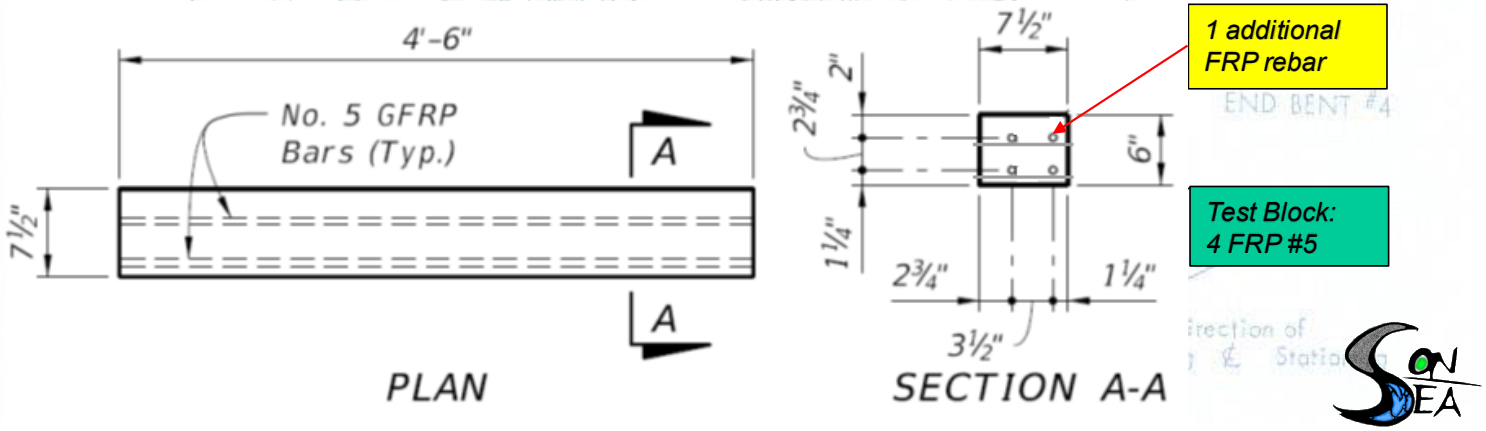
Wall	Rebar position in test block						Block extraction from casting		Concrete
	i	ii	iii	iv	v	vi			
1A	CFRP 0.6"		GFRP #5		BFRP #5		12	months	Green
2A	GFRP #5		BFRP #5		CFRP 0.6"		12	months	Green
3A	BFRP #5		CFRP 0.6"		GFRP #5		28	days	Green
1B	BFRP #5		CFRP 0.6"		GFRP #5		24	months	Green
2B	CFRP 06"		GFRP #5		BFRP #5		24	months	Green
3B	GFRP #5		BFRP #5		CFRP 0.6"		6	months	Green
4A	CFRP 0.6"		GFRP #5		BFRP #5		TBD		Conventional
5A	GFRP #5		BFRP #5		CFRP 0.6"		TBD		Conventional
6A	BFRP #5		CFRP 0.6"		GFRP #5		TBD		Conventional
4B	BFRP #5		CFRP 0.6"		GFRP #5		TBD		Conventional
5B	CFRP 0.6"		GFRP #5		BFRP #5		TBD		Conventional
6B	GFRP #5		BFRP #5		CFRP 0.6"		TBD		Conventional
GW	CFRP 0.6"		GFRP #5		BFRP #5		12 months	24 months	RCA
GW	CFRP 0.6"		GFRP #5		BFRP #5		12 months	24 months	RAP

Test blocks from RCA and RAP Gravity Walls (with CFRP, GFRP & BFRP)

Original FRP rebar configuration



New FRP rebar configuration



Test blocks from RCA and RAP Gravity Walls (with CFRP, GFRP & BFRP)

New FRP rebar configuration

24 test blocks of each RCA and RAP concrete mixes

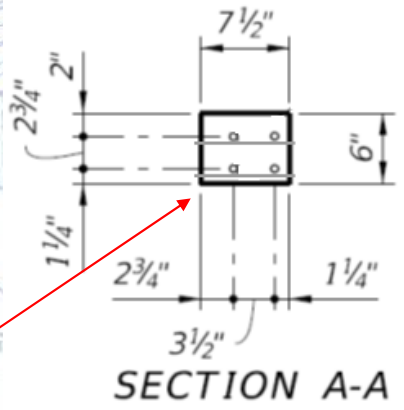
8 test blocks with 4 CFRP 0.6" Carbon fiber strand

8 test blocks with 4 GFRP #5 Glass fiber rebar

8 test blocks with 4 BFRP #5 Basalt fiber rebar

(half the blocks cast with conventional RCA and RAP mixes & half with green RCA and green RAP mixes)

Test Block: 4 FRP #5

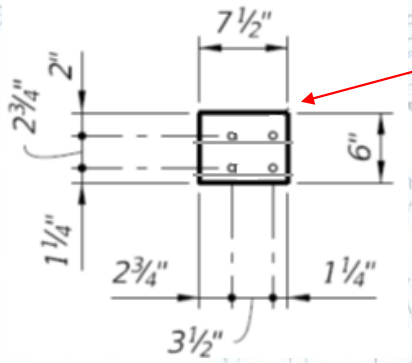


Form work

Twin-block Forms built for ease of transportation to be done with blocks still in forms after the 7th day of casting

Test blocks from White Cement and Slag Blend Traffic Parapets (with GFRP only)

Test Block:
4 GFRP rebars



Form work

12 test blocks of each WHITE CEMENT and SLAG BLEND concrete mixes

Test blocks with 4 GFRP Glass fiber rebar

Test blocks are cast separately (not attached to the parapets)

Twin-block Forms built for ease of transportation to be done with blocks still in forms after the 7th day of casting

Questions ?

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