

2018 FTBA Construction Conference

February 8 & 9, 2018

Orlando, FL



Bakers Haulover Cut Bulkhead Rehabilitation

Presentation by:

Joaquin (Jake) Perez, PE - Principal



Bolton Perez & Associates
Consulting Engineers

Bakers Haulover Cut Bulkhead Rehabilitation

Project Name:

SR A1A/Collins Avenue over Haulover Cut Bridge
Rehabilitation

Bridge Number: 870071

FPID #: 433378-1



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FDOT Project Manager:

Pablo J. Orozco, PE

Prime Consultant & EOR Bridge Rehabilitation:



Subconsultant & EOR Bulkhead Rehabilitation:



Bolton Perez & Associates
Consulting Engineers

Construction Contractor:



Kiewit

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Project Location:
FDOT District Six,
Miami-Dade County
City of Bal Harbour,
Florida



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Presentation Content and Focus:

- Glass Fiber Reinforced Polymer - GFRP
- Use on Bulkhead Wall Reinforcement
- Project Background
- Design Challenges
- Wall Study & Selected Alternative
- Comparative Cost Analysis-Carbon Steel vs GFRP
- Plan & Shop Drawing Details - GFRP
- Construction Details - GFRP
- Summary & Lessons Learned



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History of Bridge & Bulkhead Wall Construction:

- Portion of previous bridge remained after Sept 1926; “The Great Miami Hurricane”
- The Cut was re-established in 1927
- The Bridge was rebuilt in 1948



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Existing Wall Conditions & Project Purpose:

- North wall built during 1948 construction
- South wall re-built using precast prestressed concrete sheet piles
- Both walls exhibited extensive reinforcement corrosion and are in poor condition

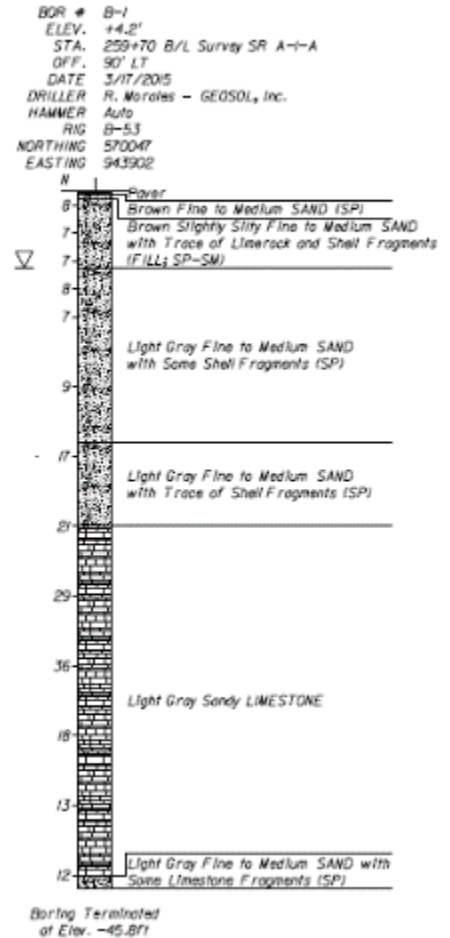
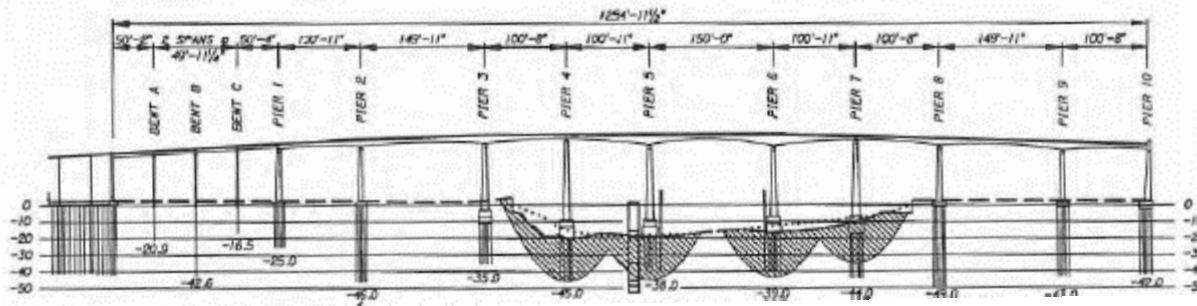


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Design Challenges:

- 8' Scour Criteria
- High water velocity in inlet from tide fluctuation



Geotechnical Conditions:

- Weathered limestone rock above minimum tip elevation

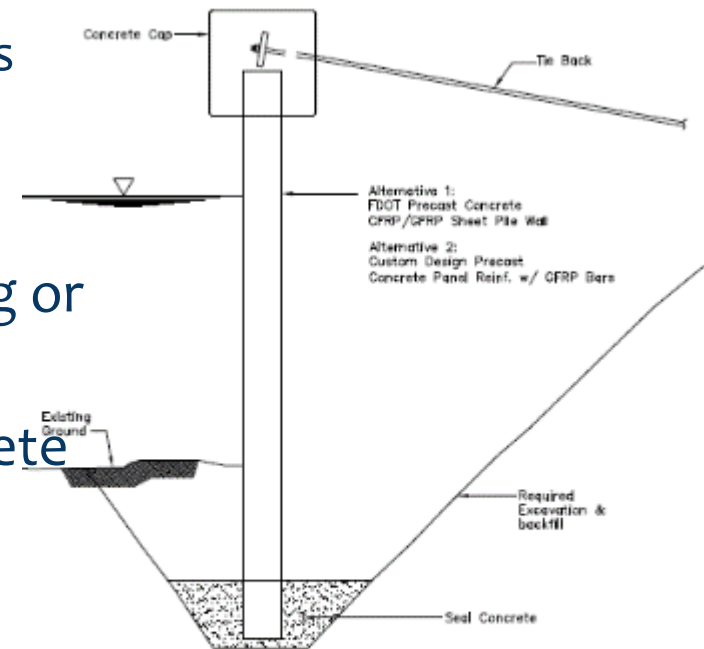


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Wall Study Alternatives:

- Precast Concrete GFRP Sheet Piles
- Custom Precast Concrete GFRP Panels
- Scour criteria required minimum tip penetration of 17-20 ft.
- Limestone rock layer precluded driving or jetting concrete sheet piles
- Depth of excavation for placing concrete panels was not feasible
- Excavation also lead to environmental permitting concerns



SECTION

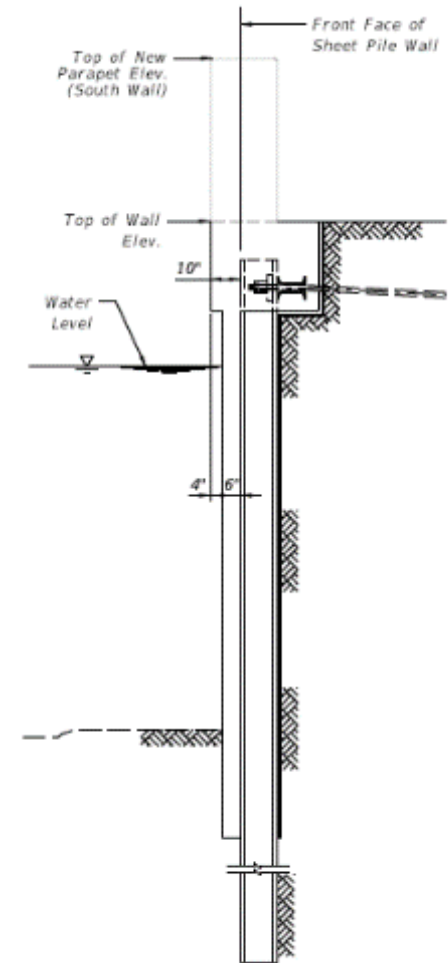


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Selected Alternative:

- Steel Sheet Piles with Concrete Fascia Panel reinforced with GFRP
- Facilitated driving to minimum tip without excavation
- Facilitated environmental permits
- Concrete fascia panel reinforced with GFRP provided extra layer of corrosion protection to steel sheet piles
- Concrete fascia panels blended well with existing adjacent concrete panel walls



TYPICAL SECTION



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Comparative Cost Analysis-Carbon Steel vs GFRP

- Demonstrated GFRP is cost effective

Cost Estimate - Reinforcing Steel					
Pay Item	Description	Quantity ¹	Unit	Unit Cost ²	Cost
400-4-8	Concrete Class IV, Bulkhead	336.8	CY	\$ 659.78	\$ 222,213.90
N/A	Concrete Additives ³	336.8	CY	\$ 40.00	\$ 13,472.00
415-1-8	Reinforcing Steel, Bulkhead	45,468	LB	\$ 1.03	\$ 46,832.04
INITIAL COST =					\$ 282,517.94
Maintenance (25% Total Cost) ⁴					\$ 70,629.49
TOTAL =					\$ 353,147.43

Cost Estimate - Glass Fiber Reinforced Polymer Bars					
Pay Item	Description	Quantity ¹	Unit	Unit Cost ²	Cost
400-4-8	Concrete Class IV, Bulkhead	336.8	CY	\$ 659.78	\$ 222,213.90
914-415-AAA	Fiber Reinforced Polymer Bar ⁵	43,303	LF	\$ 2.00	\$ 86,606.00
TOTAL =					\$ 308,819.90

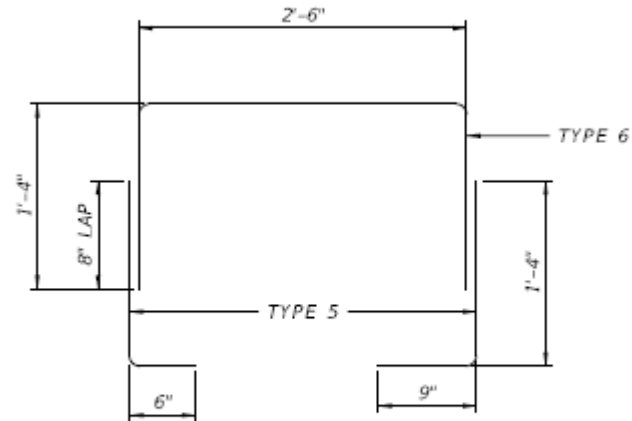
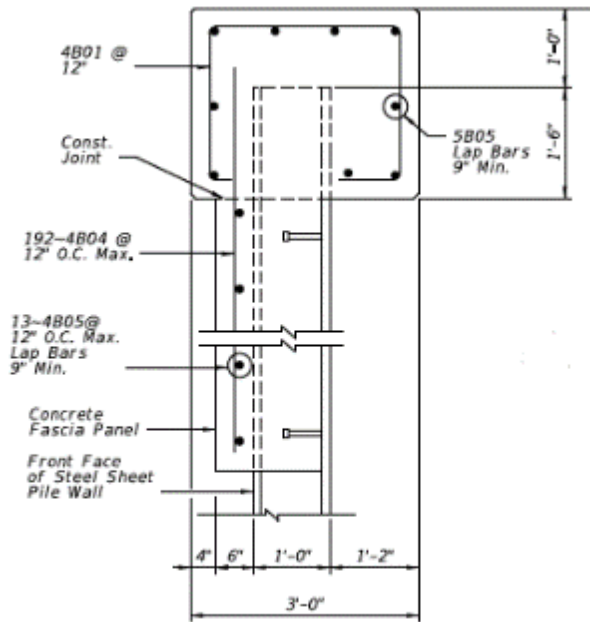
2. Unit Costs from FDOT Area 13 Item Average Unit Cost from 2014/03/01 to 2015/02/28.
3. **Corrosion inhibiting admixtures used for steel reinforced concrete construction in extremely aggressive environments.**
4. **Maintenance after the first 20 year life span of the conventionally reinforced bulkhead wall.** Cost of maintenance 25% of initial cost of construction. A longer service life of the concrete components is expected if GFRP reinforcing is used therefore, no maintenance cost was considered.
5. The unit cost of the Fiber Reinforced Polymer Bar taken from FDOT State Materials Office.



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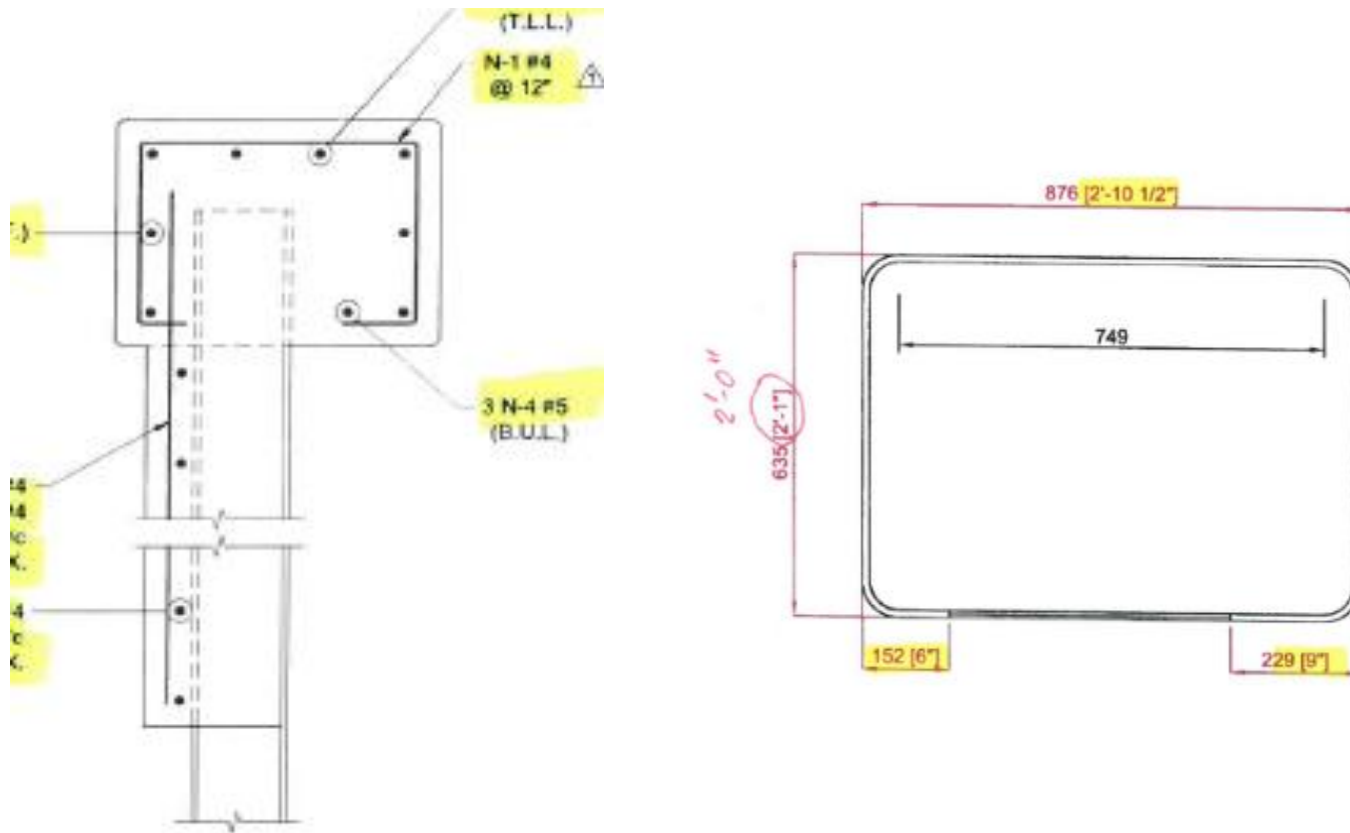
Plan Details - GFRP



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Shop Drawing Details - GFRP



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Construction Details



Placing and tying GFRP rebar in jig



Hoisting GFRP rebar mat for placement in form



Divers placing GFRP mat in forms



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Construction Details



Bulkhead wall cap GFRP reinforcement in place



Const. Jt. btw fascia panel and cap



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Completed Wall



Completed view of North Wall



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Summary of Benefits & Lessons Learned – Use of GFRP

- Reduces long term maintenance cost
- Eliminates corrosion issues associated with carbon steel
- Achieves desirable service life
- Light weight and easy to handle with small equipment
- Higher bid unit price-may have resulted from risk due to unfamiliarity with new product or limited GFRP quantities
- As we become more familiar with the use of GFRP, the more cost effective it will become.

