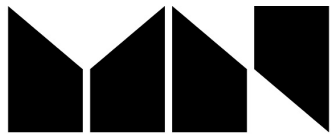


TRI - REGIONAL JETS 2025



Innovations and Collaboration:

Acquiring and Delivering Waterfront Restoration and
Modernization Projects



moffatt & nichol

Creative People, Practical Solutions





Innovation and Collaboration in Acquiring and Delivering Waterfront Restoration and Modernization Projects

Moderator:

Angela Schedel, PHD, PE, Director of Coastal Programs

Speakers:

- Isaac Canner, PE, Senior Marine Structural Engineer, Moffatt & Nichol
- CDR Brian Mack, PE, Public Works Officer, NS Mayport, NAVFAC SE
 - Evan Boyce, PE, Waterfront Structural Engineer, NAVFAC SE
 - Chelsea Marajh, PE, Waterfront Structural Engineer, NAVFAC SE

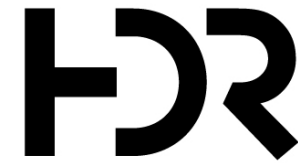


MODERATOR

Angela Schedel PhD, PE

HDR

Director of Coastal Programs



- **Sports Teams:** Go Navy, Beat Army!
- **Vacation Spots:** Recently hiked to the top of Half Dome in Yosemite
- **Did You Know:** My family's boat shop designed and built wooden boats for 70+ yrs
- **Hobbies:** Sailing, Scuba diving, Stand-up Paddleboarding
- **Cooler Project(s):** Resilient Heritage in the Nation's Oldest City – St Augustine

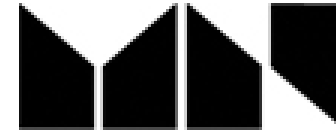


PRESENTER

Isaac Canner PE

Moffatt & Nichol

Senior Marine Structural Engineer



moffatt & nichol

- **Sports Teams:** Florida Gators, Tampa Bay Bucs and Lightning
- **Vacation Spots:** Mountains, Rivers and Beaches
- **Did You Know:** Engineer-Diver for 10 years at M&N; graduated high school in Japan
- **Hobbies:** Water Sports, Hiking and Biking
- **Coollest Project:** Poseidon Wharf Repairs at NOTU, Cape Canaveral



moffatt & nichol



Learning Objectives

- Life Cycle of Waterfront Structures and Degradation Mechanisms
- Tools For Planning A Waterfront Restoration Project
- Case Studies:
 - Planning and Executing a Successful R&M project
 - AUTECH Pier 1902 Repair
 - Cape Canaveral, NOTU Poseidon Wharf Repairs
 - JB Charleston, TC Docks Inspection and Load Rating Analysis



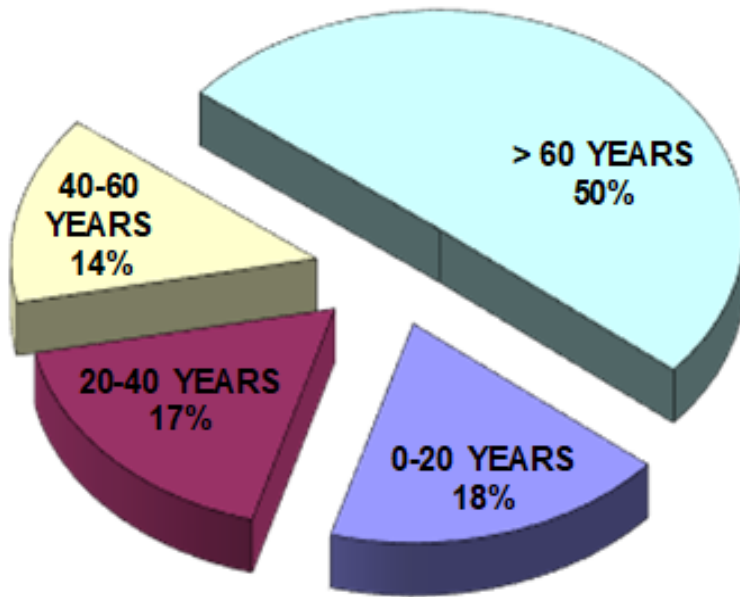
Agenda

- Life cycle of waterfront structures
- Tools for Planning a Waterfront Restoration and Modernization Project
- Innovation and Collaboration Design Phase, Acquisition and Construction
- Case Studies and Lessons Learned
- Q&A / Discussion

What is the typical life of Navy waterfront structures? (from Construction to Replacement)

- a) 40 years
- b) 60 years
- c) 80 years
- d) 100 years

AGE OF NAVY WATERFRONT FACILITIES BY PERCENT
22 July 2022

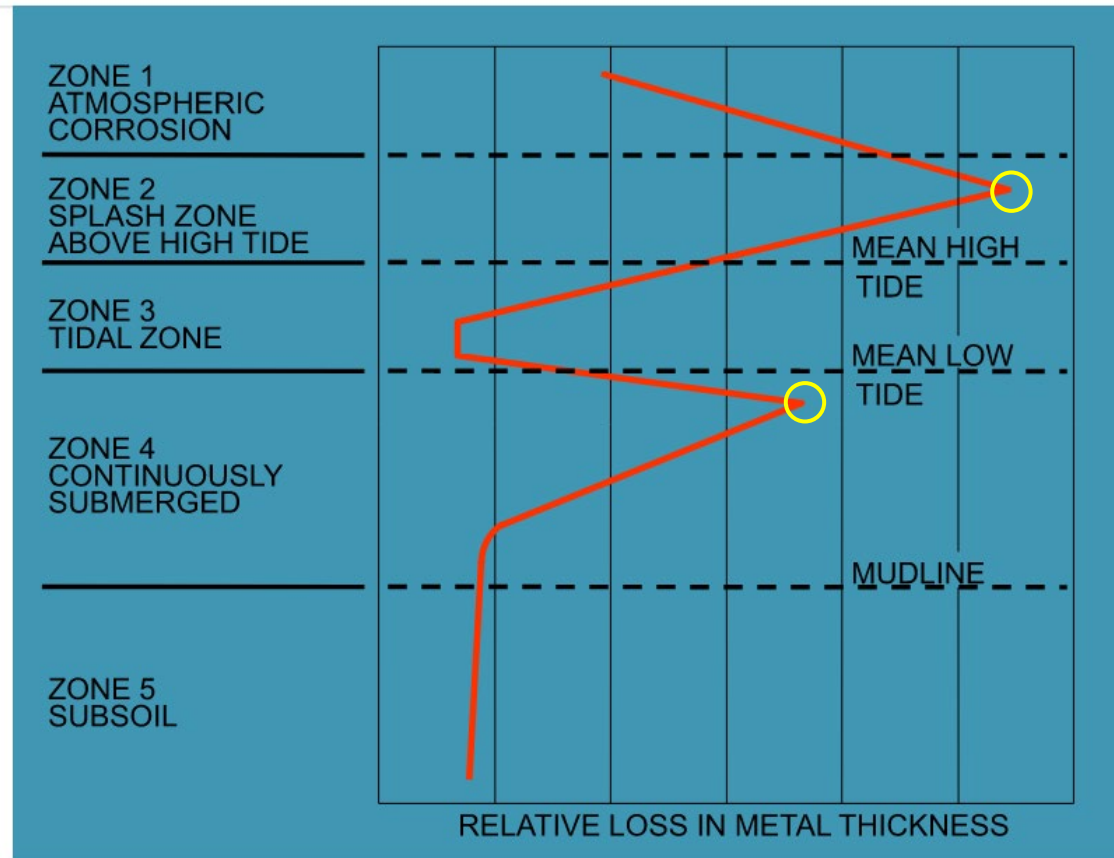


Waterfront Structure Degradation Mechanisms

- Saltwater Exposure (Most Common)
 - Corrosion of reinforcement in concrete
 - Corrosion of steel exposed to saltwater
 - Dissimilar metal corrosion
- Abrasion and Impact Damage
- Expansive Concrete Reactions (Less Common)
 - Alkali-silica reaction (ASR)
 - Alkali-aggregate reaction (AAR)
 - Delayed ettringite formation (DEF)
 - Sulfate attack
- Anodic Ring Effect at concrete repairs
- Timber Fungal Decay, Marine Borers

Steel Degradation – Corrosion Damage

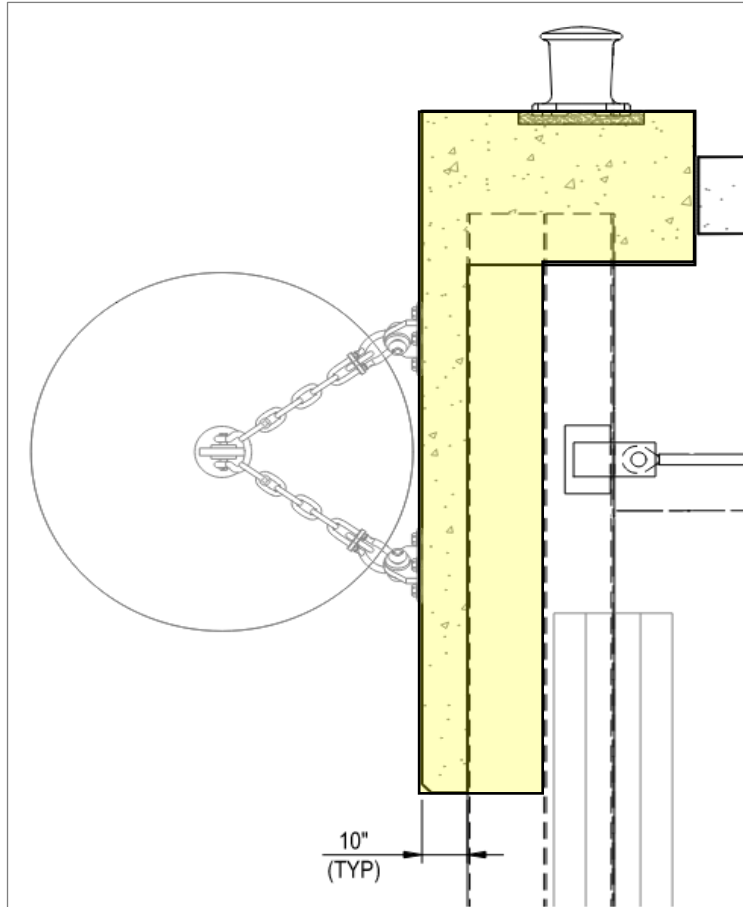
Corrosion Zones in Saltwater



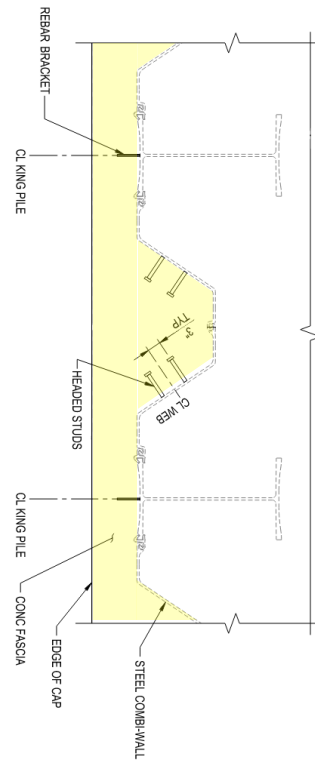
Splash Zone Corrosion



Splash Zone Corrosion – Steel Sheet Pile Protection



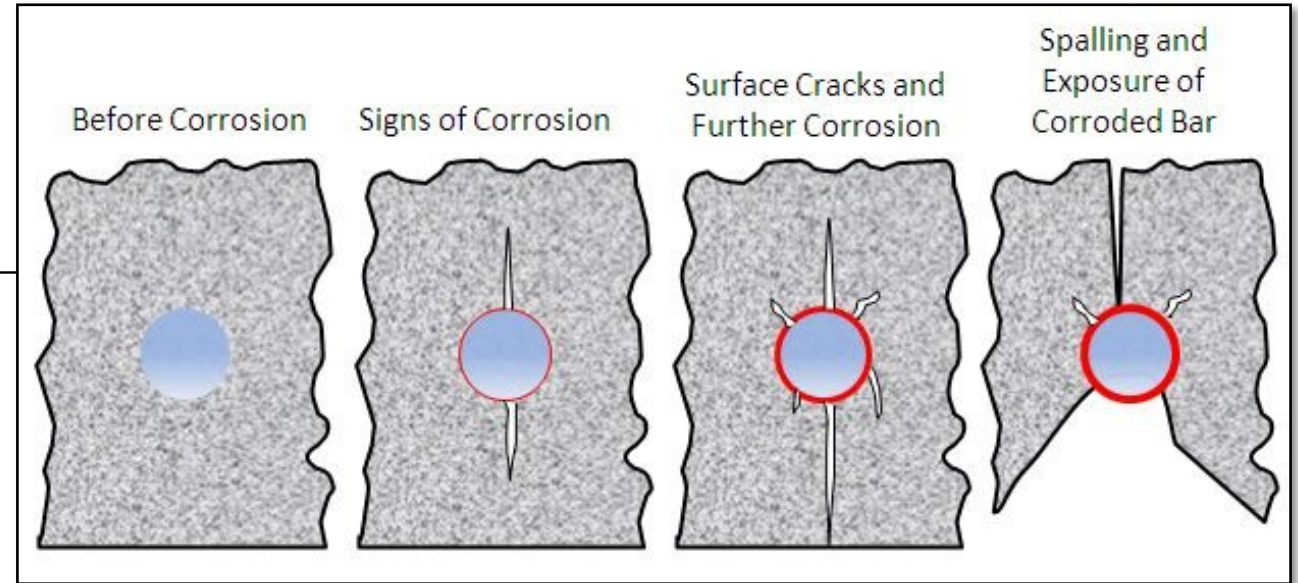
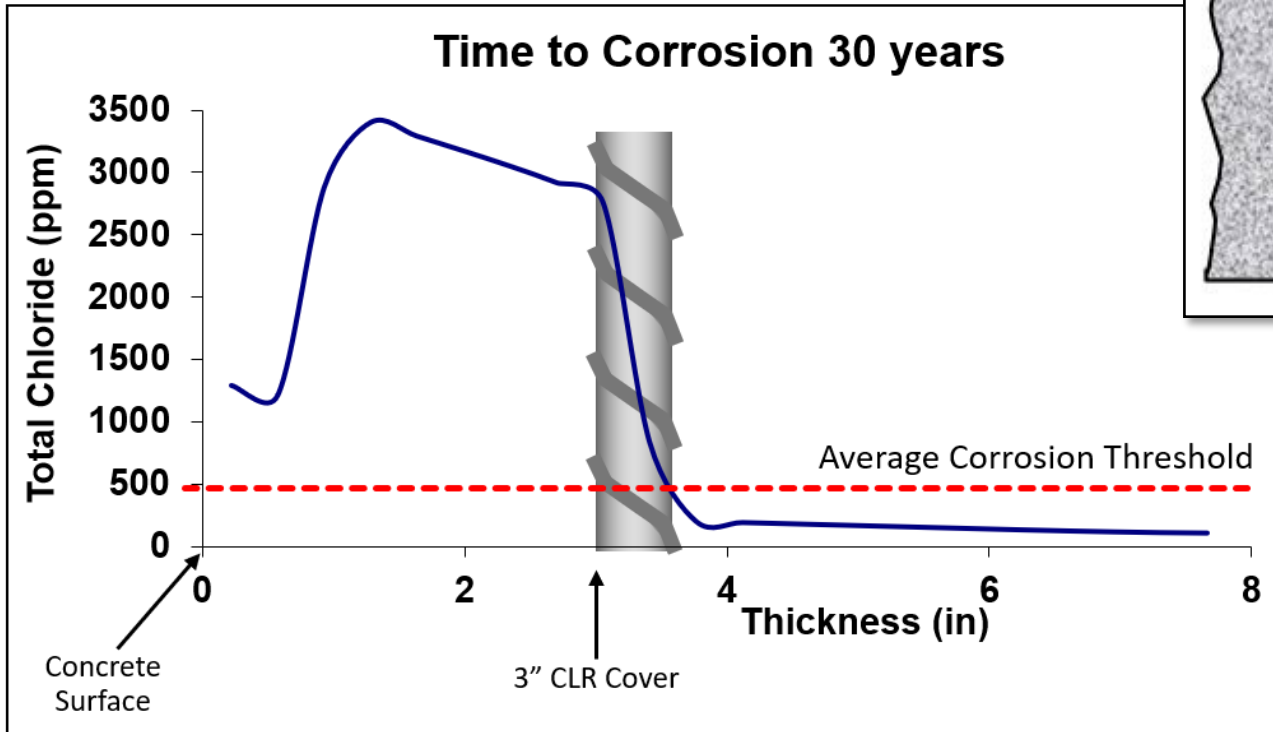
SECTION VIEW



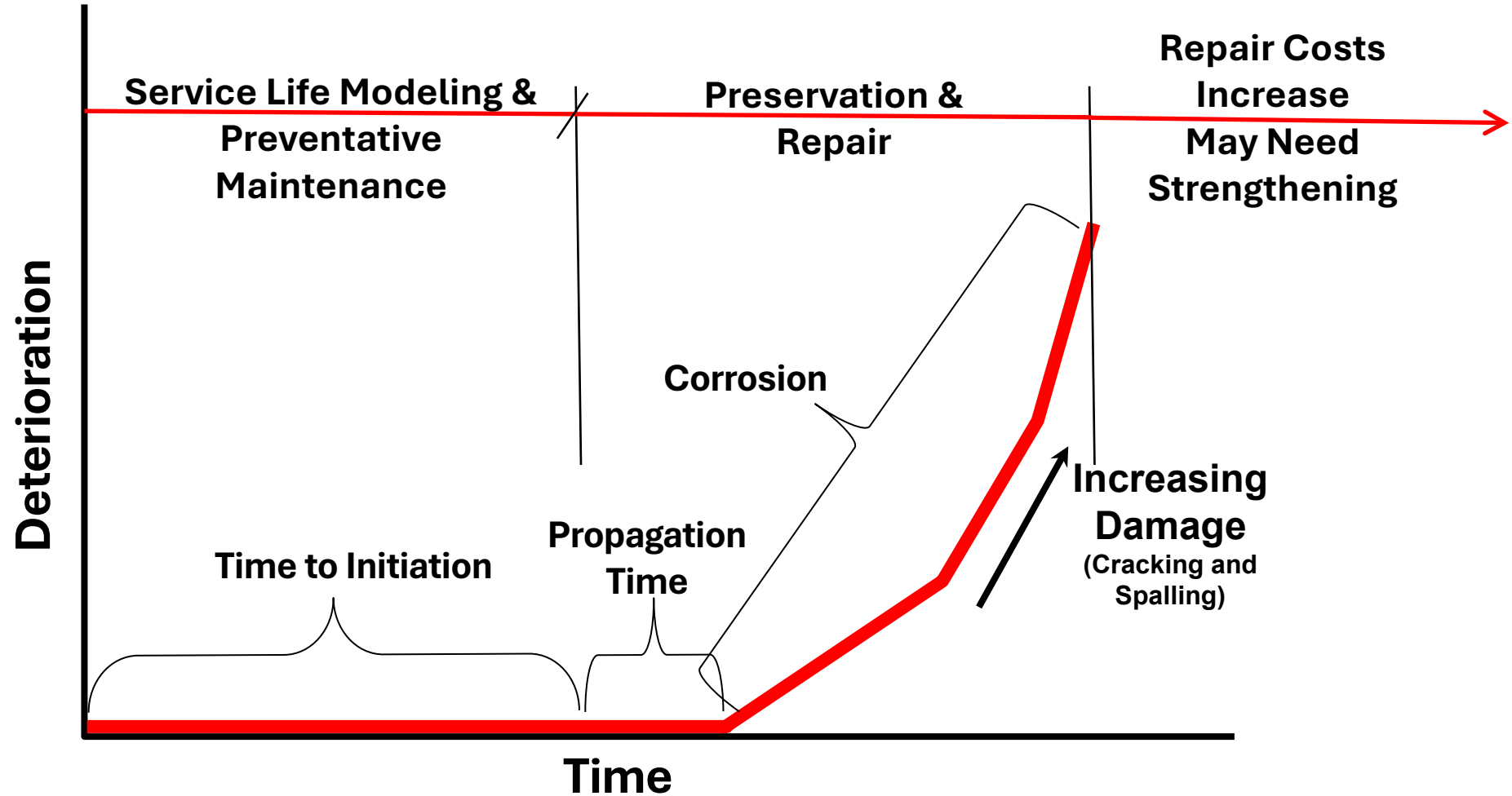
PLAN VIEW



Concrete Degradation – Corrosion Damage

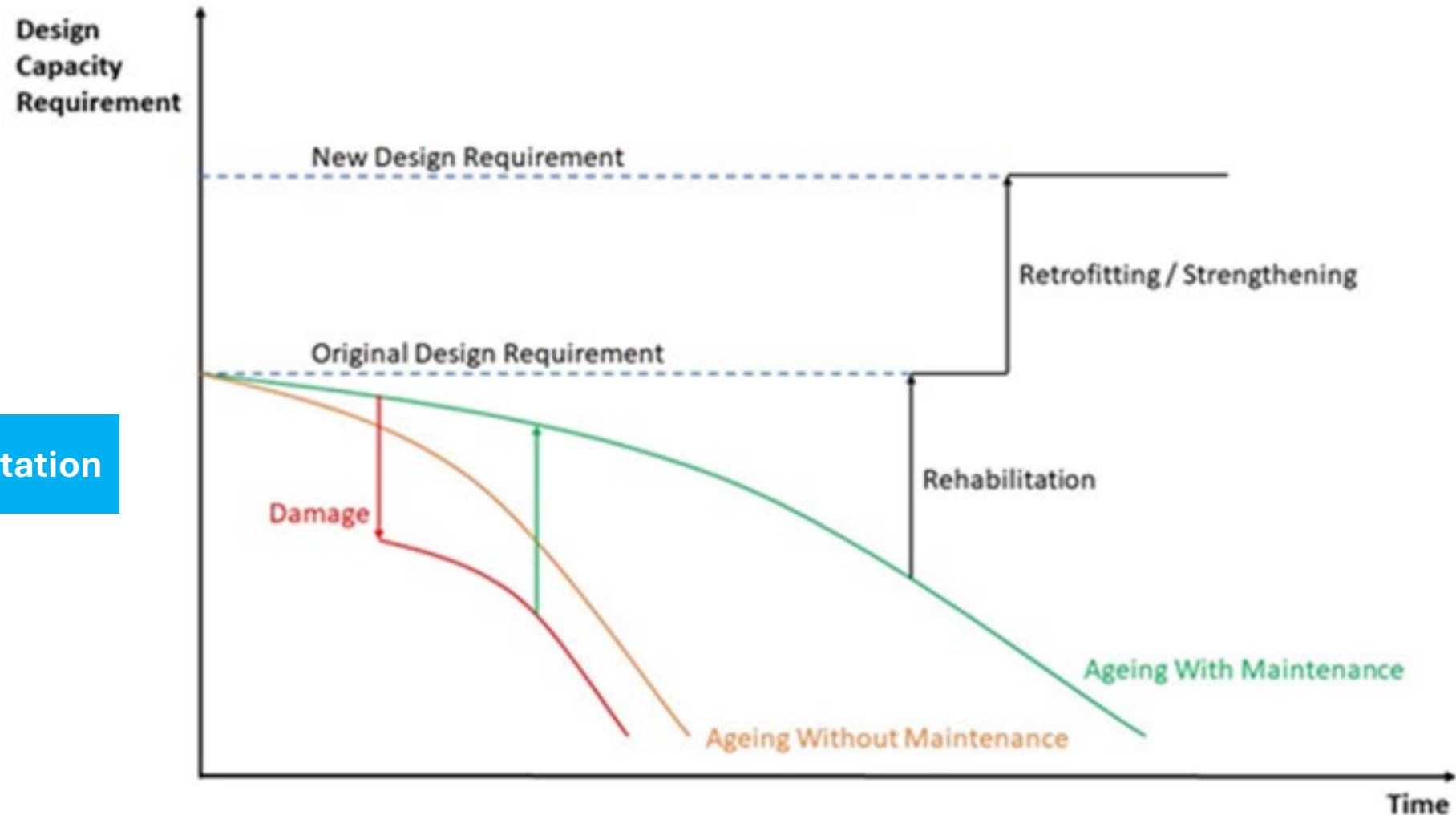
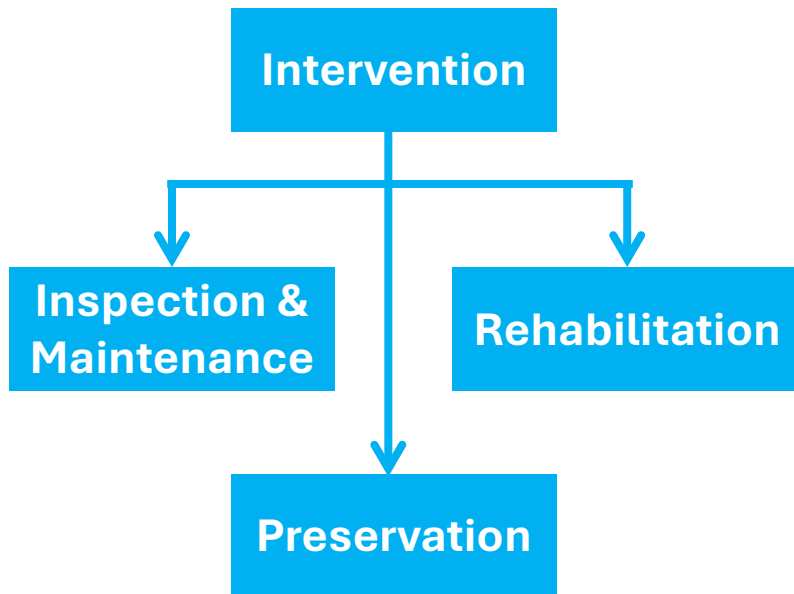


Concrete Deterioration – Corrosion Damage



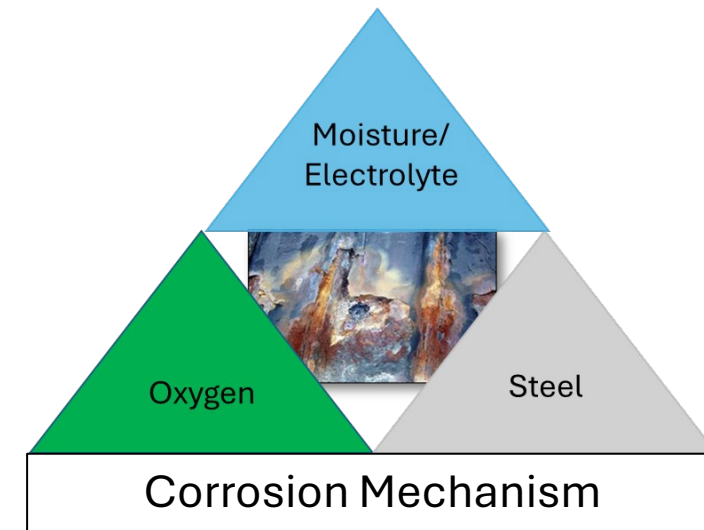
Maintenance – Preservation – Rehabilitation

- Early Intervention is Most Economical



Determine Structural Repair Requirements

- **How to Repair:** Determine the cause of degradation
 - Design Repairs to stop the degradation mechanism
 - Sealers, Coatings, Barriers
 - Cathodic Protection: Galvanic Anodes or Impressed Current
- **What to Repair:** Design Level Inspection
 - **Engineering Information:** Gather data to bracket the repair scenarios
 - Concrete sampling and testing (chloride profile, chemical degradation, etc)
 - Cathodic Protection Testing, Ultrasonic thickness measurements
 - **Contractor Information:** Verify existing conditions that affect constructability
 - Site obstructions that impact access to complete repairs.
- **When to Repair:** Planned Intervention
 - **Condition:** Damage severity, Rate of degradation, structural impacts if not repaired
 - **Planning:** Operational need date, Funding Availability
 - **Project Duration:** Field Investigation + Design + Permitting + Construction Phase



Tools for Planning a Waterfront Restoration and Modernization Project





PRESENTER

CDR Brian Mack ^{PE}
NAVFAC SE / NAVSTA Mayport
Civil Engineer Corps
US Navy



- **Sports Teams:** The Citadel Bulldogs, Clemson Tigers, and Jacksonville Jaguars
- **Vacation Spots:** Beaufort, SC & Disney World
- **Did You Know:** Built a barndominium and POM-24 in the same year.
- **Hobbies:** Golf and Embracing the Girl-Dad Life
- **Cooler Projects:** POM-24 and Onslow Beach Bridge Replacement (Camp Lejeune)

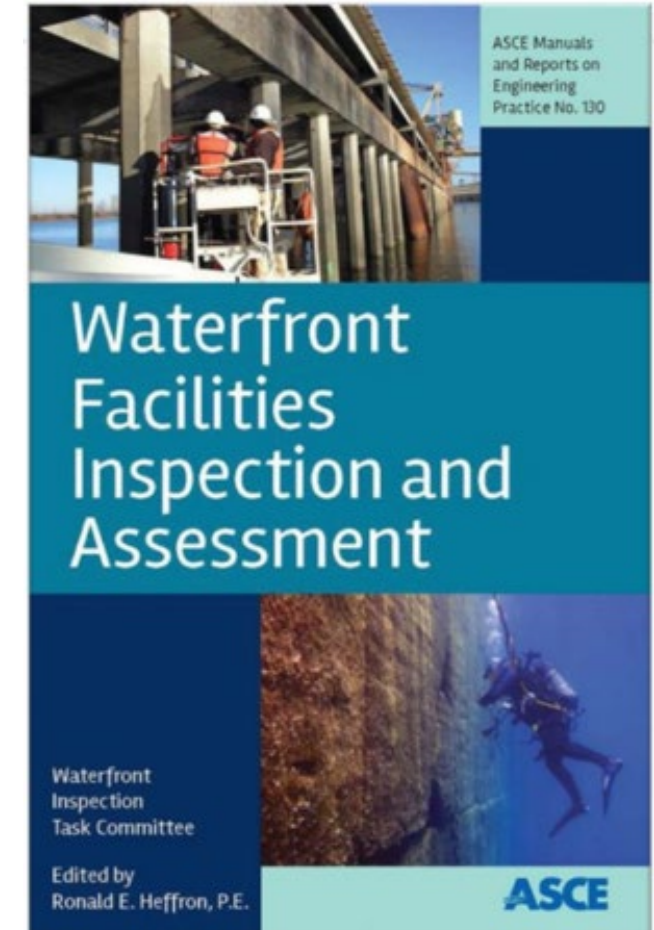


Inspection Cycles

- Requirements
- UFC 4-150-07 Maintenance of Waterfront Facilities
 - Timber Structures – 3 Year Cycle
 - Steel Structures – 6 Year Cycle
 - Concrete Structures – 6 Year Cycle
- Special Circumstances
 - Pacific Northwest (Concrete Defects)
- Technical Warrant Authority
 - FEC CHENG

TYPES OF WATERFRONT INSPECTIONS

- ***Routine Inspections (90% of our inspections)***
 - Assess the Overall Condition of a Facility
 - Assign a Condition Assessment Rating (Condition Index)
 - Develop Recommendations for Repairs with Planning Cost Estimates
 - Recommend Interval for Inspection Cycle
- ***Design Level Inspection (Requires FEC & PWD approval)***
 - Detailed Routine Inspection
 - Documentation of Location, Size, Quantity and Repair Method for Defects
 - Detailed Repair Cost Estimate
- ***Construction Inspection***
 - QA/QC to Verify Compliance with Design
 - Verify Pay Quantities
 - Develop Punch-List for Deficiencies
- ***Post Event Inspection***
 - Rapid Investigation to Determine Damage & Integrity of Facility
 - Develop Recommendations for Repairs



CONDITION INDEX (CI) RATINGS

Assessment Rating	Equivalent CI Rating	Description
"Good"	84 – 100	No problems or only minor problems noted. Structural elements may show some very minor deterioration, but no significant reduction in structural capacity.
"Satisfactory"	67 – 83	Minor to moderate defects and deterioration observed, but no significant reduction in structural capacity.
"Fair"	54 – 66	All primary structural elements are sound; but minor to moderate defects and deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the structural capacity.
"Poor"	37 – 53	Advanced deterioration or overstressing observed on widespread portions of the structure. Some reduction in structural capacity.
"Serious"	26 – 36	Advanced deterioration, overstressing or breakage may have significantly affected the load bearing capacity of primary structural components. Local failures are possible.
"Critical"	0 – 25	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur.

Report Format - Executive Summary

Executive Summary Table

Facility	Material	Engineering Assessment Rating	CI	Operational Rating	Operational Restrictions			Repair Costs
3.1 - Wilson Cove Pier NFA100000763765 221754	Concrete, Steel	Fair	66	C3	Deck Loading	Vessel Mooring	Vessel Berthing	\$ 2,110,361
					No	Yes	Yes	
3.2 - Wilson Cove Seawall NFA100000763694 221717	Concrete	Satisfactory	75	C1	Deck Loading	Vessel Mooring	Vessel Berthing	\$ 83,350
					No	No	No	
3.3 - Wilson Cove Ramps NFA100000764906 227338	Concrete	Satisfactory	73	C1	Deck Loading	Vessel Mooring	Vessel Berthing	\$ 19,471
					No	No	No	
3.4 - North Light Pier NFA200000132731 290154	Concrete, Steel	Good	87	C1	Deck Loading	Vessel Mooring	Vessel Berthing	\$ 172,679
					No	No	No	
3.5 - NOTS Pier NFA100000764238 225724	Concrete, Steel	Good	89	C1	Deck Loading	Vessel Mooring	Vessel Berthing	\$ 758,549
					No	No	No	



Report Format - BUDGETARY ROM Estimate (Appendix C)

Cost Estimate - Wilson Cove Ramps

ACTIVITY AND LOCATION Naval Auxiliary Landing Field San Clemente Island					CONSTRUCTION CONTRACT NO.				IDENTIFICATION NUMBER		
					ESTIMATED BY Collins Engineers, Inc.				CATEGORY CODE NUMBER		
PROJECT TITLE Wilson Cove Ramps - NFA100000764906 - 227338					STATUS OF DESIGN _X_ PED ___ 35% ___ 65% ___ 100% ___ FINAL				JOB ORDER NUMBER		
UNIFORMAT II CODE	ASSET TYPE	ITEM DESCRIPTION	QUANTITY		MATERIAL COST		LABOR COST		ENGINEERING ESTIMATE		
			No.	UNIT	UNIT COST	TOTAL	UNIT COST	TOTAL	UNIT COST	TOTAL	
H1030		Deck Components									\$11,400
H103004	CRB1	Repair missing curb section.	19	LF	\$350	\$6,650	\$250	\$4,750	\$600		\$11,400
										Subtotal	\$11,400
Z10		Overhead and Profit									
Z1010		Construction Costs							10%		\$1,140
Z1020		Overhead							15%		\$1,710
Z1030		Profit							10%		\$1,140
Z1040		Contingency							5%		\$570
										Subtotal	\$15,960
Z20		Design Allowance									
Z2020		Engineering Design							6%		\$958
Z2030		Engineering PCAS							1%		\$160
Z2040		Title 2							4%		\$638
Z2050		SIOH							8%		\$1,277
										Subtotal	\$18,992
Z30		Inflation Allowance									
Z3010		Inflation Allowance							3%		\$479
										Estimated Budget Amount	\$19,471

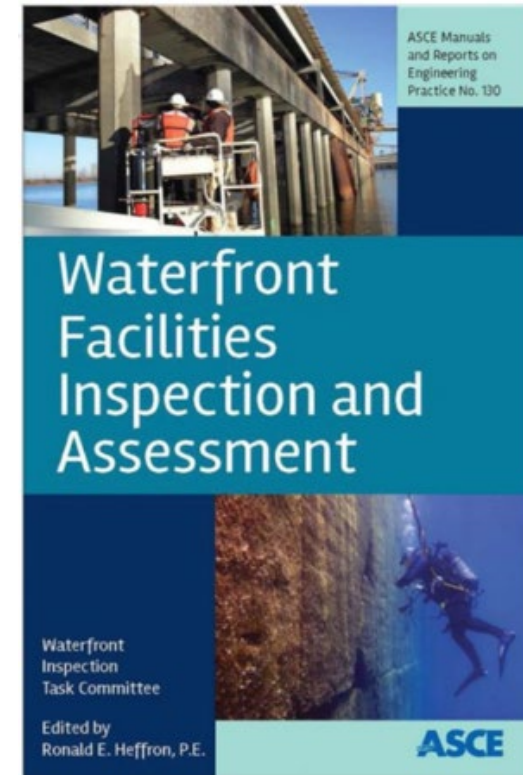


Federal Planning a Waterfront R&M Project

- Funding Sources
 - MILCON
 - Emergency Construction
 - Contingency Construction
 - UMMC – Unspecified Minor Military Construction
 - Operation & Maintenance Budget
 - Hurricane Funding
- Project Timeline
 - From EXWC Report to Inducted Project
 - From Induction to Construction
- Impacts of Timeline on a Project
 - Increased damage resulting in higher construction costs
 - Change orders for additional repair quantities and schedule delays

Tools for Planning a Waterfront R&M Project

- NAVFAC EXWC Waterfront Inspection Reports
- Record Drawings and Previous Studies
- End User Input:
 - Operational and Vessel Requirements
 - Understanding past/current/future operations
- UFC Criteria and Industry References
 - 4-150-07 Maintenance and Operation: Maintenance of Waterfront Facilities
 - 4-150-08 Mooring Hardware Inspection
 - 4-152-01 Piers and Wharves
 - 4-159-03 Moorings
 - ASCE Waterfront Inspection & Assessment Manual of Practice No. 130 (2015)
 - PIANC WG-233 Inspection, Maintenance & Repair of Waterfront Facilities (~2026)
- Environmental Permitting per USACE, State, & Local Regulatory Agencies





End User Input – Operational Requirements

- Desired Design Life
- Live Load Capacity of Structure
 - Change of use
 - Mobile Truck Crane Operations
 - Repair with Strengthening to remove load restrictions
- Mooring Type: is Heavy Weather Mooring Required?
 - Mooring and Fender system Capacity
- Utility Services and Capacity
 - Electrical shore power or industrial power
 - Ship to shore utilities (Sewer, Water, Compressed Air, Fuel, etc.)
- Maintenance Dredging



Waterfront R&M - Project Delivery Method

Delivery Method: Design – Bid – Build

Construction Contractor: Lump Sum Bid

- Open Bid with Minimum Quals for Marine Construction Experience
- 8A Small Business Contractor with Marine Construction Subcontractor
- MACC Contractor with Marine Construction Subcontractor
- Need experienced specialty Contractor, ex: Shotcrete Repairs

Waterfront R&M – Lessons Learned

Construction Phase: Concrete Spall Repairs

- Field verify repair dimensions per Drawings prior to demolition.
- Measure dimensions, verify quantities
Example: $2' \times 2' = 4 \text{ sq ft}$
 $2.5' \times 2.5' = 6.25 \text{ sq ft}$ (3 inches over all the way around)
 - Result **50% increase in quantity!**
- If have overage, then prioritize severe damage and critical parts of structure

Design Phase: Constructability Review

- Identify attachments, utilities, additional work that is incidental to the repair work.
- Identify accessibility and access to perform the work.
- Identify the Contractor's laydown area: where is it relative to the project site.

Operational Impacts During Construction

- Include downtime for unforeseen Navy operations
- Phased Construction to allow operations
- What work can occur during Navy Operations



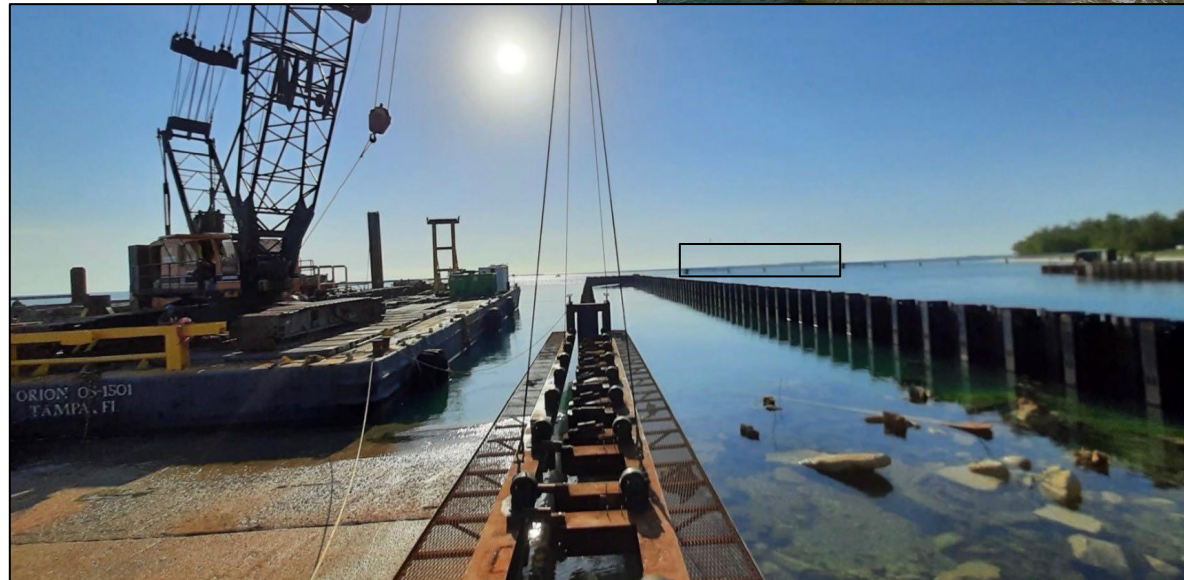
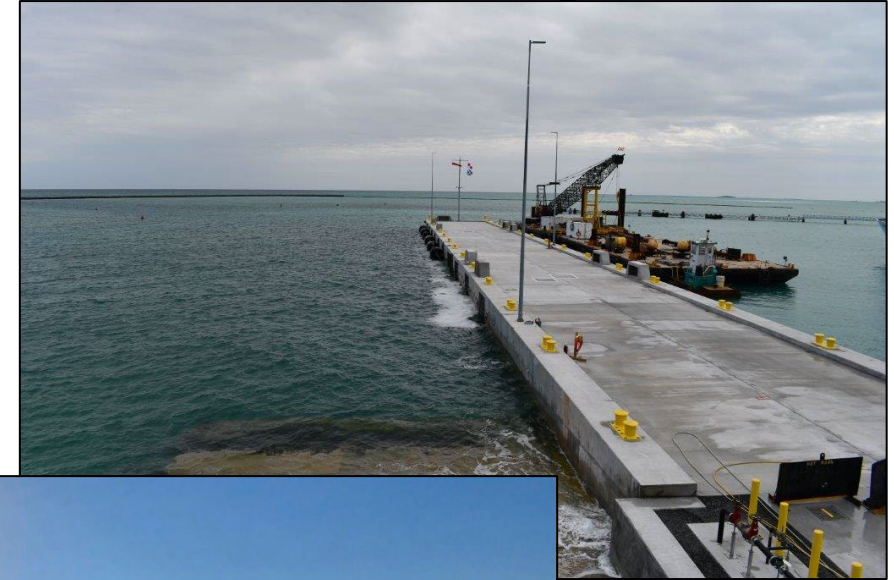
Case Studies



Case Study: AUTEC Andros Island - Pier Repair

1963 Construction

- 52 ft wide x 484 ft long
- Steel H-pile supported Pier
- Live Load Restrictions
- Severe corrosion damage
- Utility services non-operational



AUTEC Andros Island - Pier Repair

1963 Construction

1987 Rehabilitation & Strengthening

2010 Condition Index of 45 (**Poor** Condition)

2015 Rehabilitation Project – Cancelled Due to Advanced Deterioration

2020 to 2021 Design Phase for Pier Repair by Replacement

Project Scope included:

- Demolish Pier / Construct Mole Pier
- Replace Utilities
- Temporary Berthing Pier

2022 Demo & Replacement

2022 Construction Cost: \$28.7 million

1963 to 2022 = 59 Year Life

Case Study: AUTECH Pier 1902 Repair

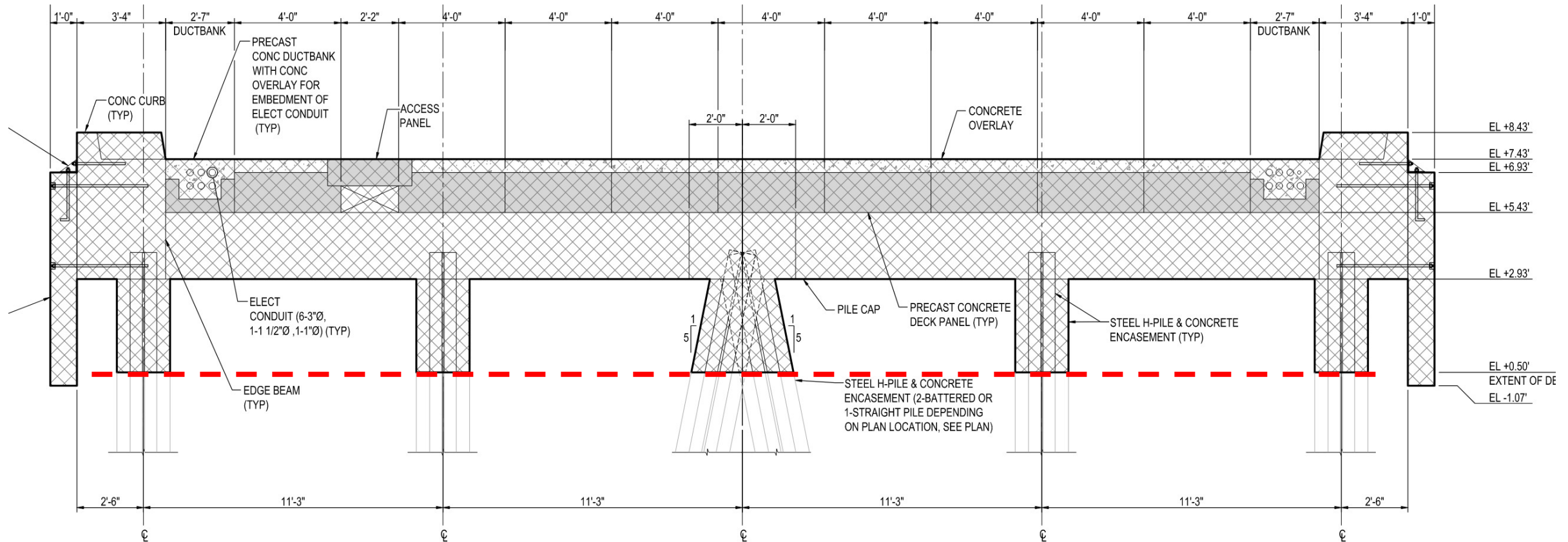
- Design-Bid-Build: \$28.7 million repair and upgrade project
- 52 ft by 484 ft long pier - Repair by Replacement with Mole Pier
 - Salvage cutoff piles, sheet pile structure filled with aggregate
- 75-year design life
 - Marine concrete mix design
 - Passive cathodic protection of sheet piles
 - Concrete fascia to protect splash zone
- **Construction – finished ahead of schedule**
 - Collaboration between Engineer – Construction Manager – Contractor
 - Work plan review meetings
 - Conference calls to discuss critical path RFIs and Submittals



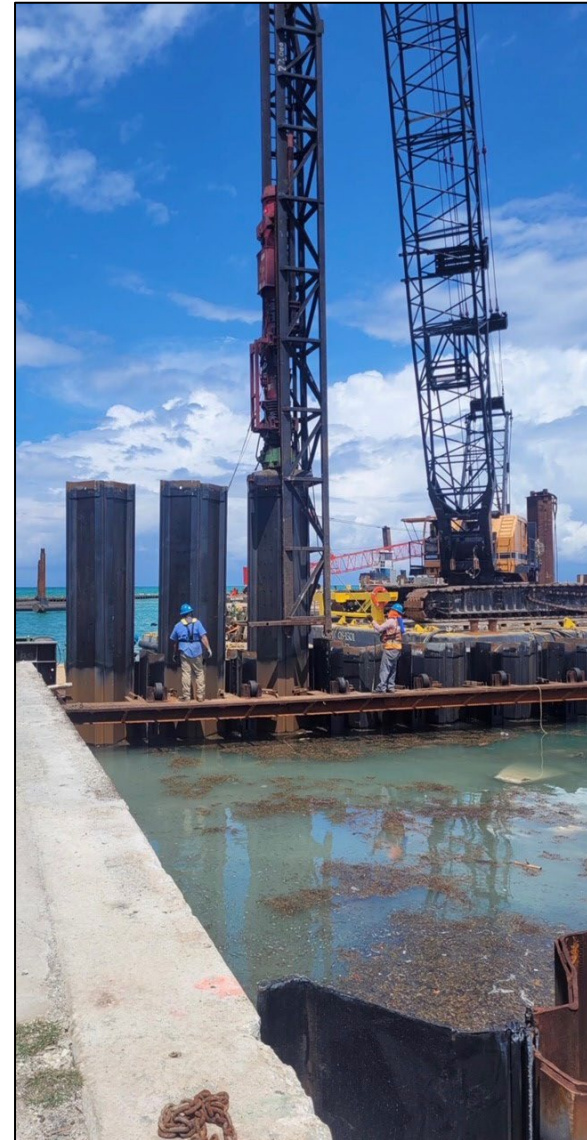
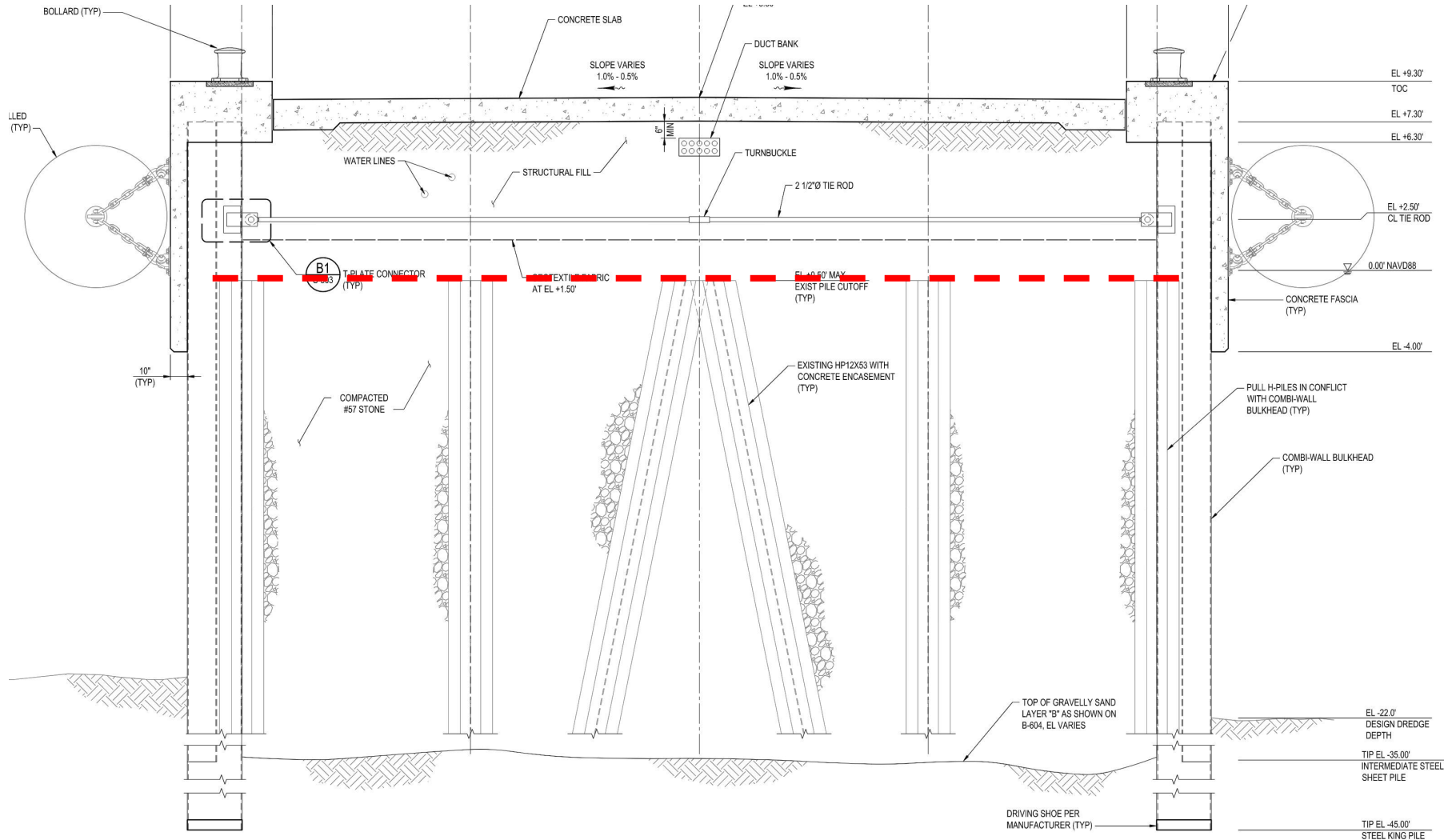
moffatt & nichol



AUTEC Pier – Demolition Section



AUTEC Pier – Mole Pier Section

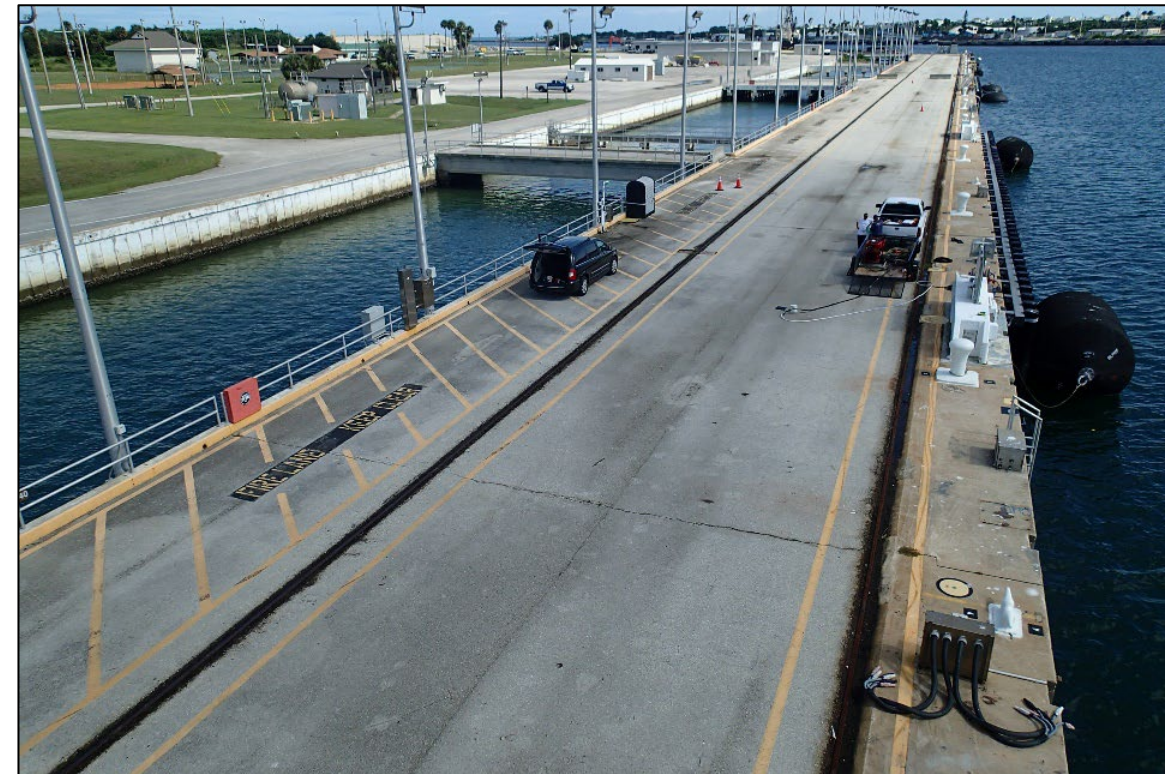


AUTEC Andros Island - Pier Repair



Case Study: Poseidon Wharf Repairs

- 1957 Construction
- 1200 ft long x 60 ft wide
- Concrete pile supported
- Gantry crane w/ insufficient capacity
- Severe concrete damage below deck
- Severe corrosion of below deck utilities



Case Study: Poseidon Wharf Repairs

1957 Construction ; 1998 Rehabilitation & Strengthening Project

2011 Fender System Replacement

2013 Condition Index of 47 (**Poor** Condition)

2017 Design Level Inspection, Concrete Testing, Alternatives Analysis

2018 to 2019 Design to Extend the Service Life by +15 Years

Project Scope included:

- Repair Substructure (pile cap concrete repairs and CP Pile Jackets)
- Replace Pier Deck for Mobile Truck Crane Operations
- Replace Utilities

2019 to 2022 Construction Phase

Construction Cost: \$34.6 million



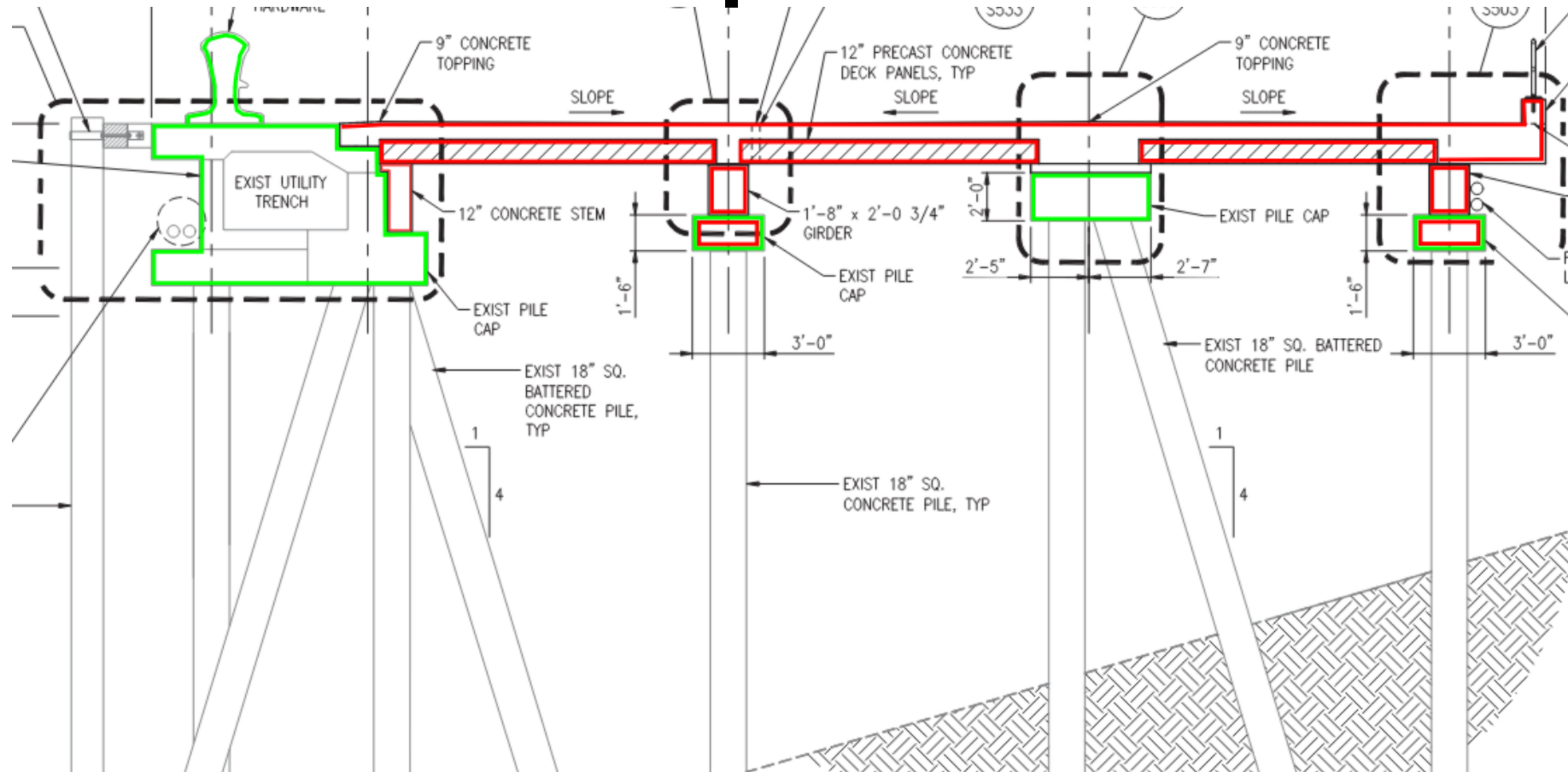
moffatt & nichol



TRITON MARINE
CONSTRUCTION CORP.

1957 to 2025 = 68 Year Life

Poseidon Wharf Repairs

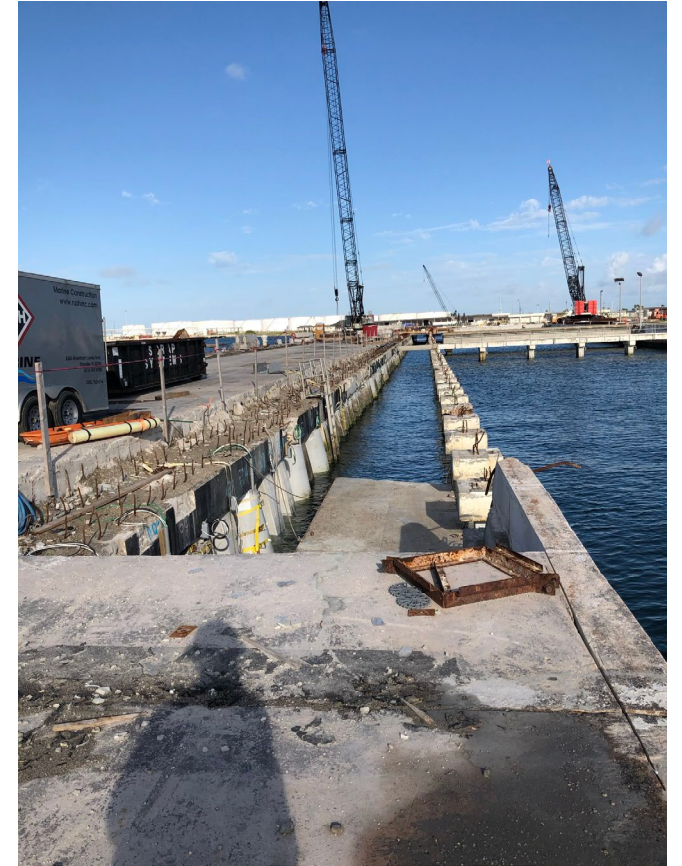


Substructure Restoration

&

Deck and Beam Replacement

Poseidon Wharf Repairs - Substructure



Poseidon Wharf Repairs – Restoration



Poseidon Wharf Repairs – Restoration



Case Study: JB Charleston SDDC TC Dock Inspection and Structural Analysis

1941 Construction

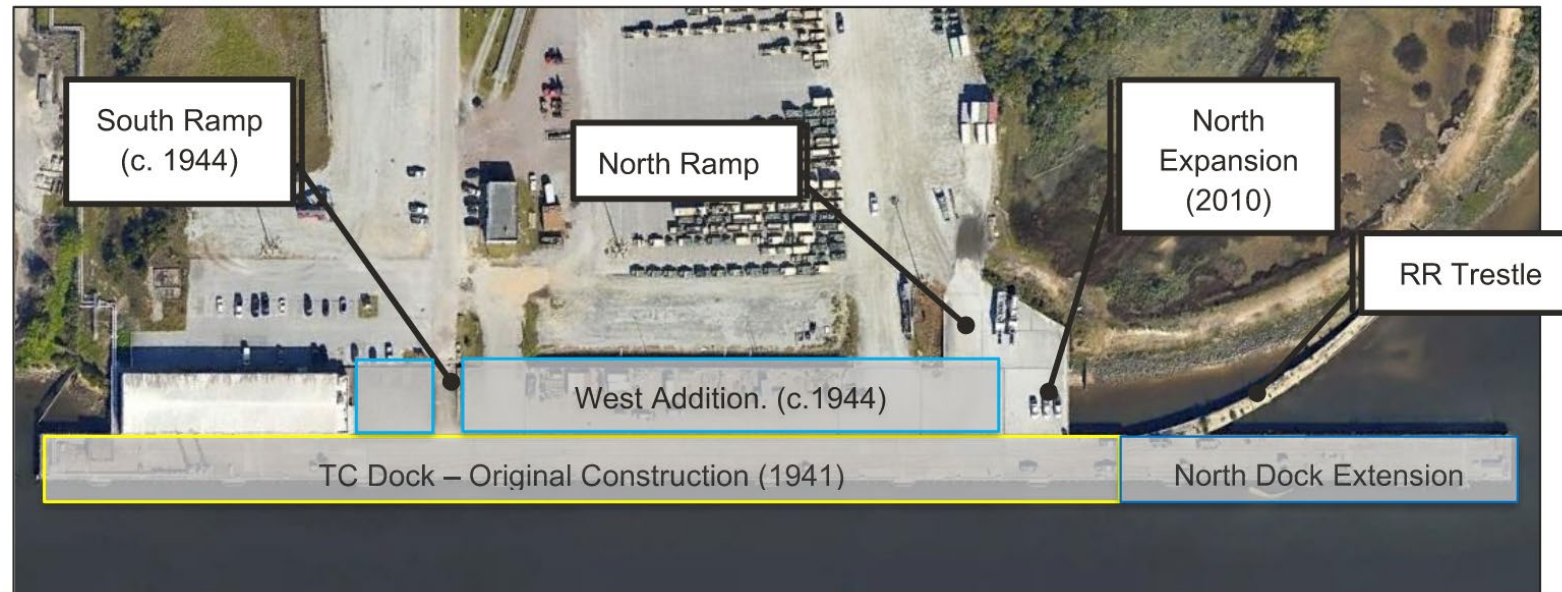
- 46 ft wide x 1,000 ft long
- Railroad trestle

1944 Expansion

1955 500 ft long extension

2010 Structural Modification

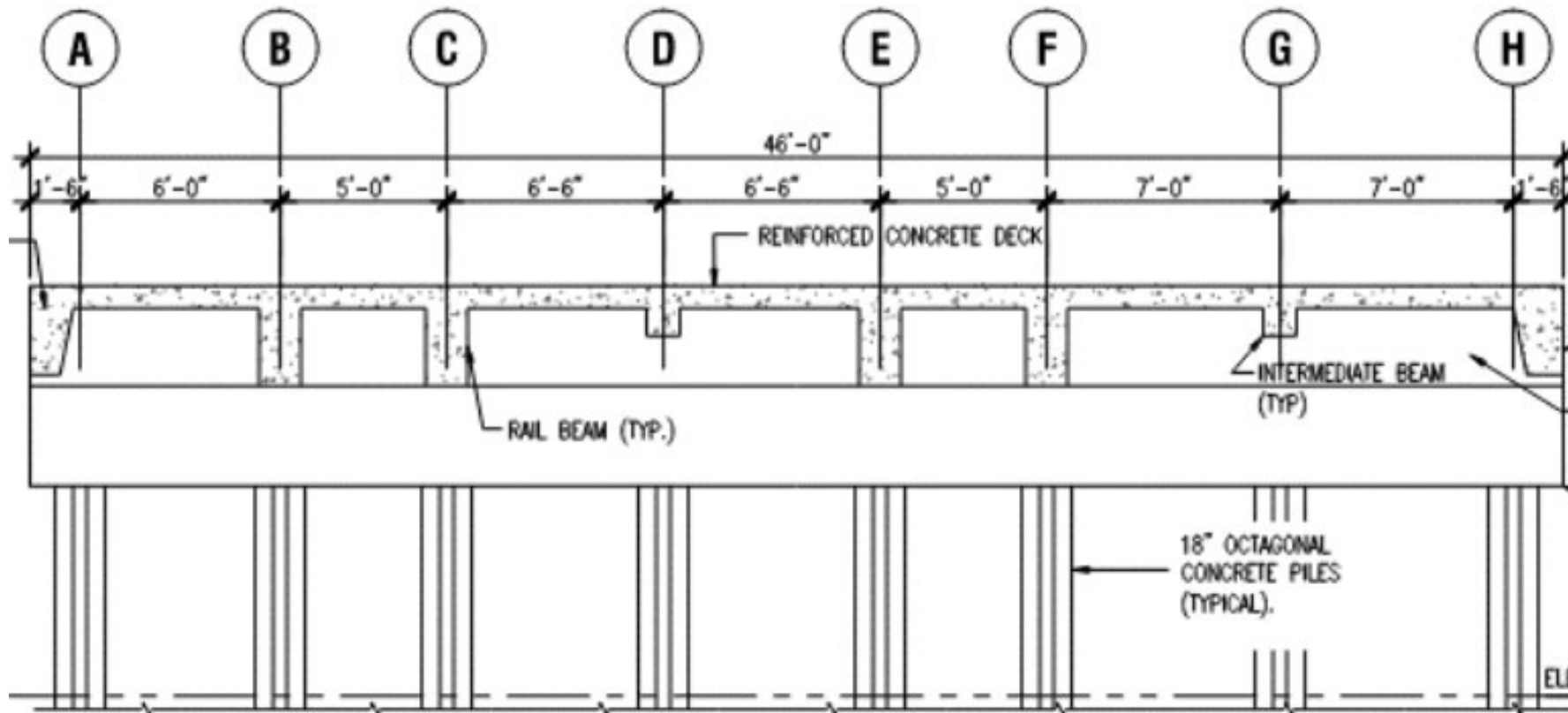
- Structural Upgrade for Mobile truck cranes



Case Study: TC Dock Inspection and Load Rating

1941 Typical Section

- Concrete beam – slab design



Case Study: TC Dock Inspection and Load Rating

Task 1 Scope:

- Structural Inspection Report completed in 2024 (per ASCE MOP130)
- Concrete sampling and testing program (65 core samples)
 - Chloride concentration, carbonation, and degree of rebar corrosion at various locations throughout the facility.
- Mooring and Berthing Analysis
- Load Rating Analysis for Live Loads
 - Recommendation: Live load restrictions, No towing tanks, Travel at slow speed.

Task 2 Scope:

- Continue monitoring superstructure condition w/ underdeck inspections on 6-month cycle.

Case Study: TC Dock Inspection and Load Rating

Task 3 Scope: Monitor Structure and Install Instrumentation

- Verify Analysis Assumptions and Loads on Structure
- Install strain gages and accelerometers attached to beams
 - Verify structural response to a known vehicle. Ex: fire truck
 - Update assumptions for load path through superstructure
- Weigh In Motion (WIM Array)
 - Verify vehicle weights that use wharf
 - Piezoelectric quartz sensors installed on a smooth stable paved surface
 - Develop site specific live load factors for the Wharf



Goal of Study: Make older structures work by verifying live loads and load distribution to structure

Q&A / Discussion



Contributors



Evan Boyce, PE

NAVFAC SE

Waterfront Engineer



Isaac Canner, PE

Moffatt & Nichol

Marine Structural Engineer



CDR Brian Mack, PE

Civil Engineer Corps

US Navy



Chelsea Marajh, PE

NAVFAC SE

Waterfront Engineer

TRI - REGIONAL JETS 2025

