Floating Pier

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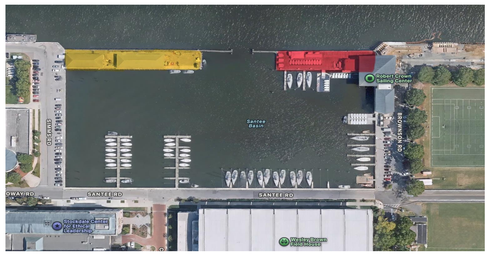
Abstract

Over the last decade, Annapolis, Maryland, has experienced an increased frequency of tidal flooding. These elevated water levels disrupt daily operations within the Santee Basin and restrict waterfront access for individuals with mobility challenges. To mitigate these impacts, this project proposes replacing the existing stationary structures with a dynamic floating pier system. This redesign will provide Yard Patrol (YP) 700-Series craft with a safe, reliable mooring platform capable of accommodating fluctuating tidal elevations and flood conditions. Comprehensive hydrodynamic force and material stress analyses were conducted to ensure structural integrity against anticipated Meteorological and Oceanographic (METOC) conditions.



Overview of Area

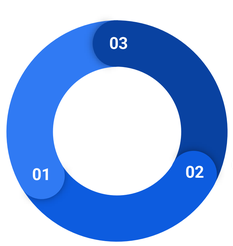
Project Objectives

Primary Objective: *Design a floating dock system adjacent to the sailing center to provide secure YP mooring while minimizing infrastructure damage to both the vessels and the Santee Basin.*

Analytical Approach: *The design process integrated environmental data analysis, SolidWorks 3D modeling, piling bending stress analysis, and structural deflection analysis to validate the proposed system.*

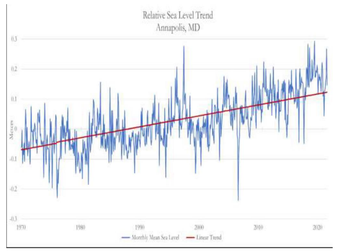
Methods

Environmental Data → Design Decisions → Component Analysis

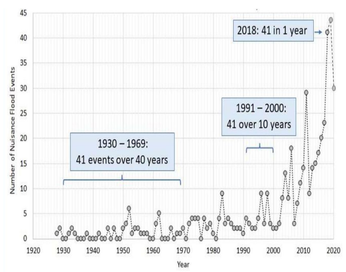


1. Piling Bending Stress
2. Piling Deflection Analysis
3. Computer Design

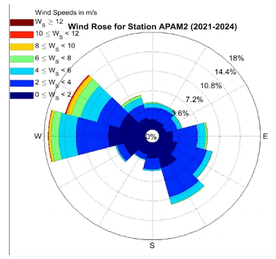
Environmental Data



Santee Basin's Sea Level 1970 - 2020

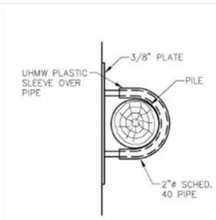


Number of flooding events 1928 - 2020



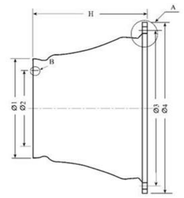
Wind direction and velocity

Design Decisions



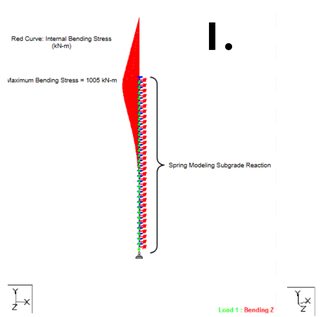
Anchoring System:
Pole & Sleeve [10]

Pier:
Single Pontoon[10]

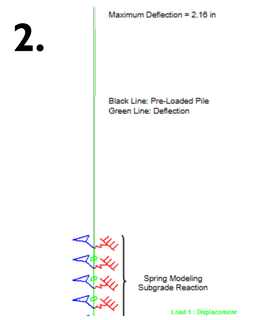


Fender:
Super Cone [16]

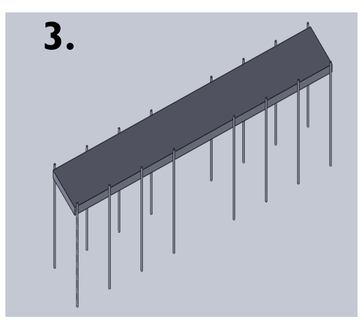
Component Analysis



Stress Analysis of Pile



Deflection Analysis of Pile



Dock System (Modeled in Solidworks)

Force Equations

Wind: $F_{wind} = A_{projected} * C_{shape} * P_{wind}$

Current: $F_{current} = ½ * \rho_{seawater} * V_{current}^2 * A_{submerged} * C_d$

Wave: $F_{wave} = |FD|*cos(kx-\omega t)*|\cos(kx-\omega t)| + |FI|*\sin(kx-\omega t)$

Berthing: $E_n = 0.5 \times MD \times VB^2 \times CM \times CE \times CC \times CS$

Results

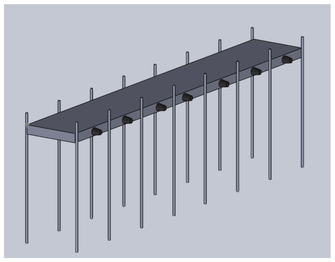
Wind: *35.05 lbf*

Current: *23.40 lbf*

Wave: *494.51 lbf/piling*

Berthing: 151.1 kips

Final Design



Materials

Piing: A36 Steel
Pier: Concrete with foam center

Pier Dimensions:

Length: 327.8 ft
Width: 48.63 ft
Height: 8 ft

Piling Dimensions:

Thickness: 0.5 inch
Diameter: 24 inches
Height: 102 ft

Super Cone Dimensions: [17]

Height: 4.27 ft
Bottom Diameter: 6.82 ft
Top Diameter: 4.18 ft

Future Considerations

Aspects outside the scope include:

- Design the red portion of site (ref top left)
- Decrease financial costs
- Create physical model of dock
- Electrical and fresh water accommodations

Each of these consideration must be included before future steps takes place.

Acknowledgements

- CAPT Gish, USN Ret.
- Professor Andrew Metzger

References