



## Alternate Blocking Materials

NSRP Panel Project PP 23-018

# Outline

- DM Consulting Introduction
- Introduction to Drydocking
- Example & Traditional Methods of Block Construction
- Description of New Materials
- Cost Comparison
- Implementation, Testing, & Deliverables
- Technology Transfer



# DM Consulting – Dry Dock Experts

- Established 2000
- Certified Dock Masters
  - 5000+ Drydocking operations.
  - 150+ Years Combined Experience
- Training, Consulting
- Dry Dock Acquisitions
- Technology Advocates
  - 3D Scanning
  - Software Development
  - Modern Supports
  - Monitoring Systems



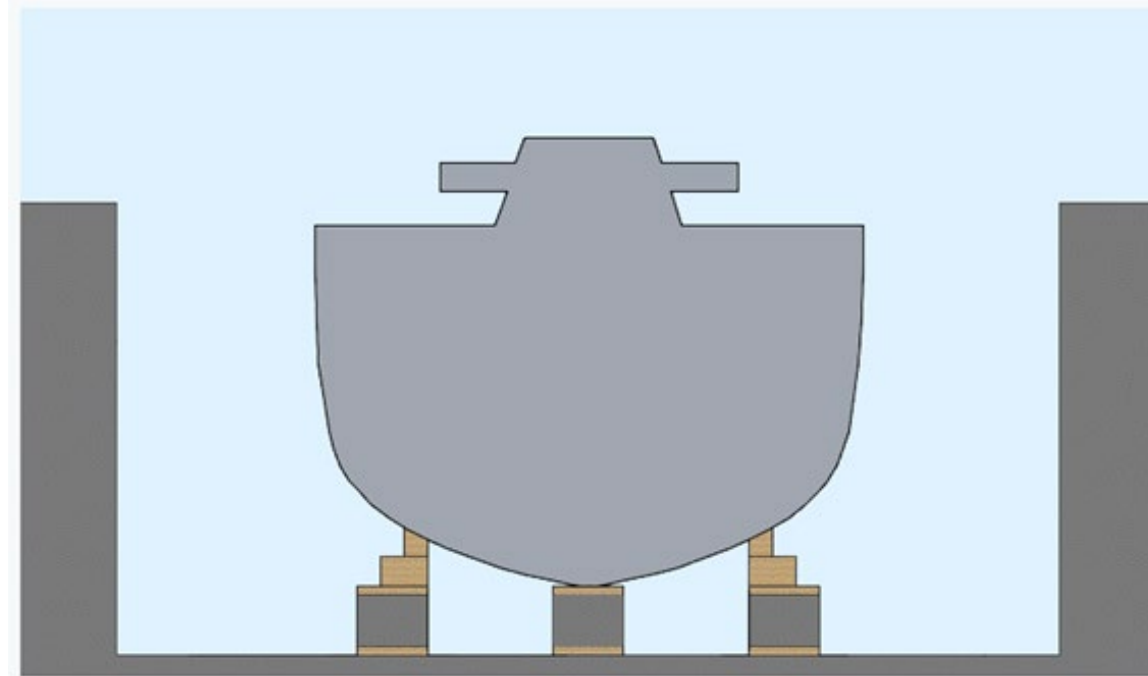
# Drydocking



# Drydocking

Keel Blocks

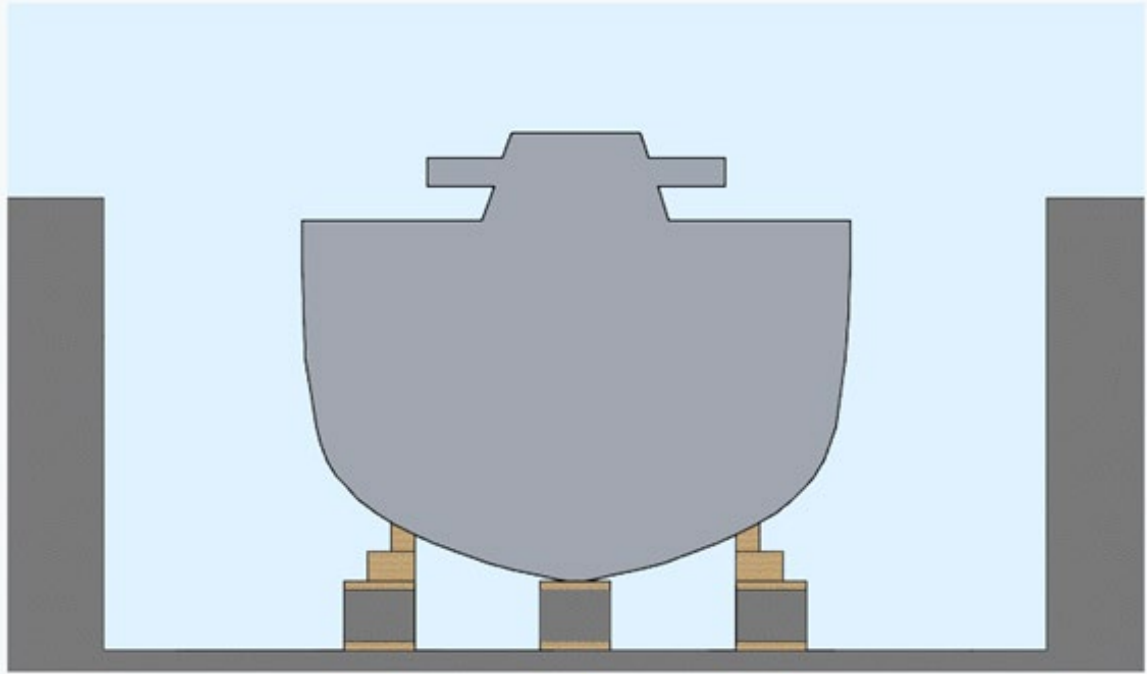
Support most of a ship's weight



# Drydocking

Side Blocks

Keep vessel upright



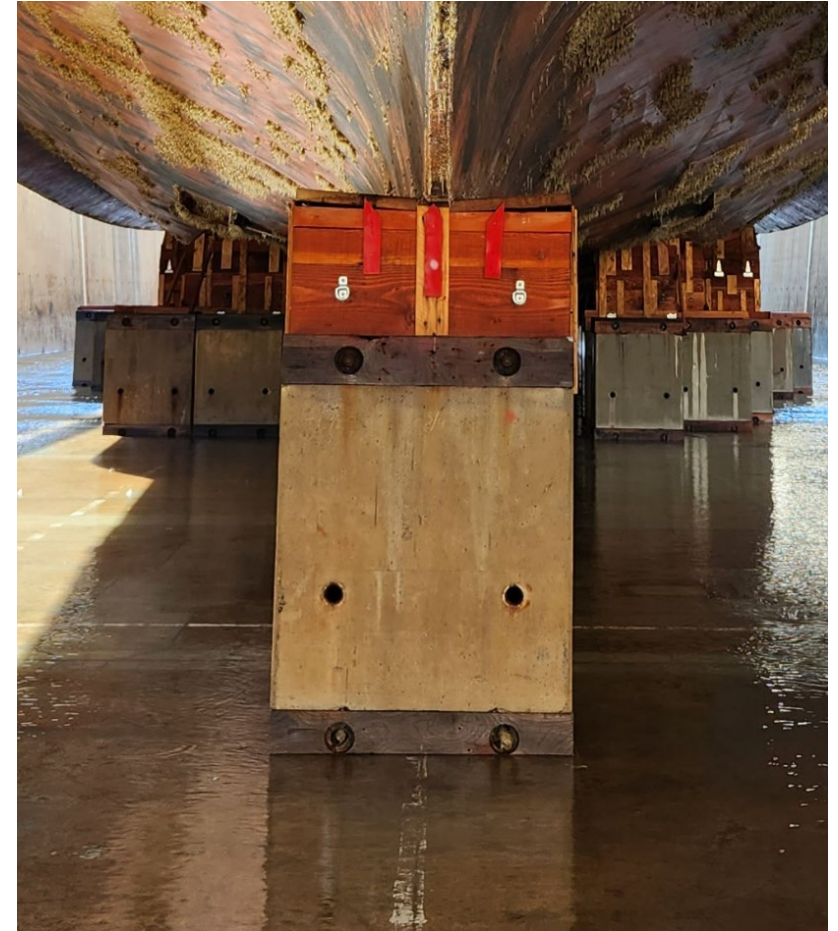
# Drydocking



# Example of Wood Used (DDG)

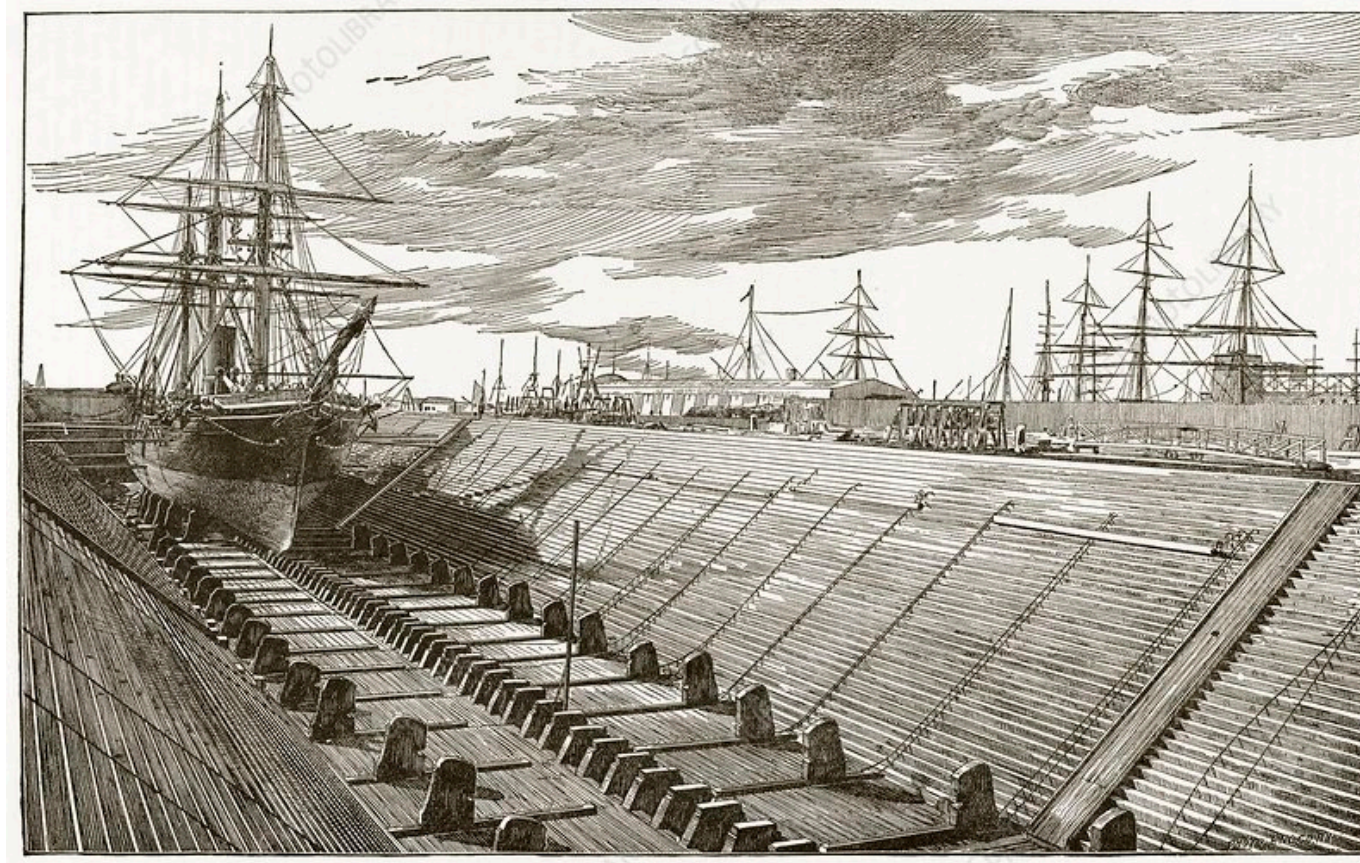


- 7.5 ft block height (shaft removal)
- 5.5 ft base block + 2 ft of soft wood
- 80 Blocks total (KB + SBs)
- Max SB height = 5 ft
- ~2600 ft<sup>3</sup>
  
- Softwood lifespan = 2 years
- Rubber lifespan = 10 years





# Block Construction History



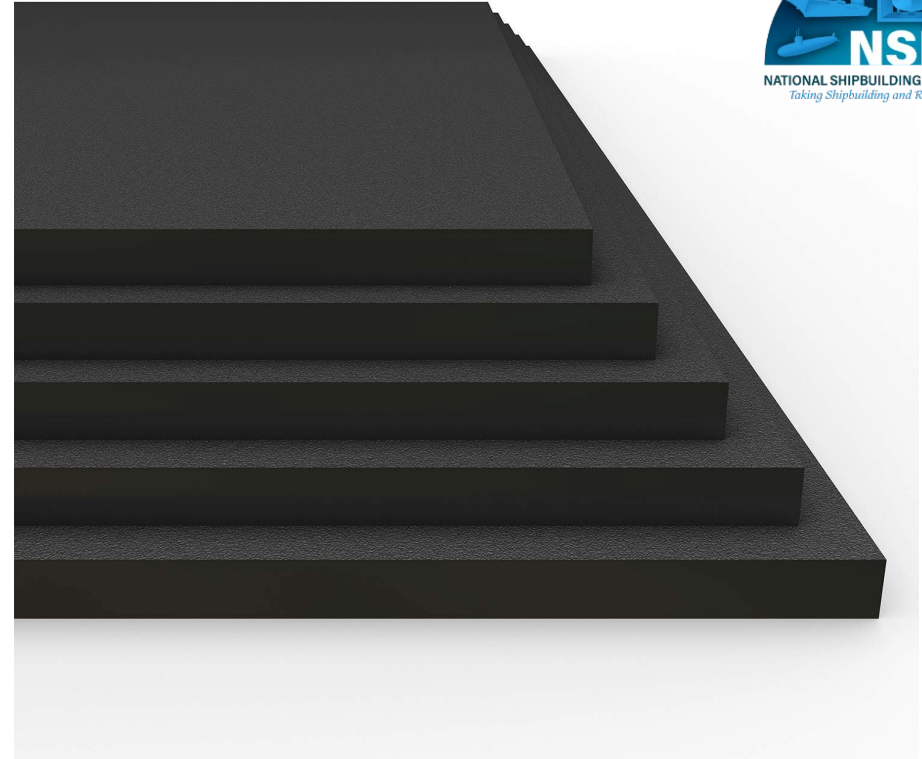
# New Materials

- High Density Polyethylene (HDPE)
  - Goal is to replace hard and/or soft wood caps
- Neoprene Pads
  - Goal is to replace hard and/or soft wood caps
- Fiber Reinforced Concrete (FRC)
  - Goal is to replace traditional steel reinforced concrete



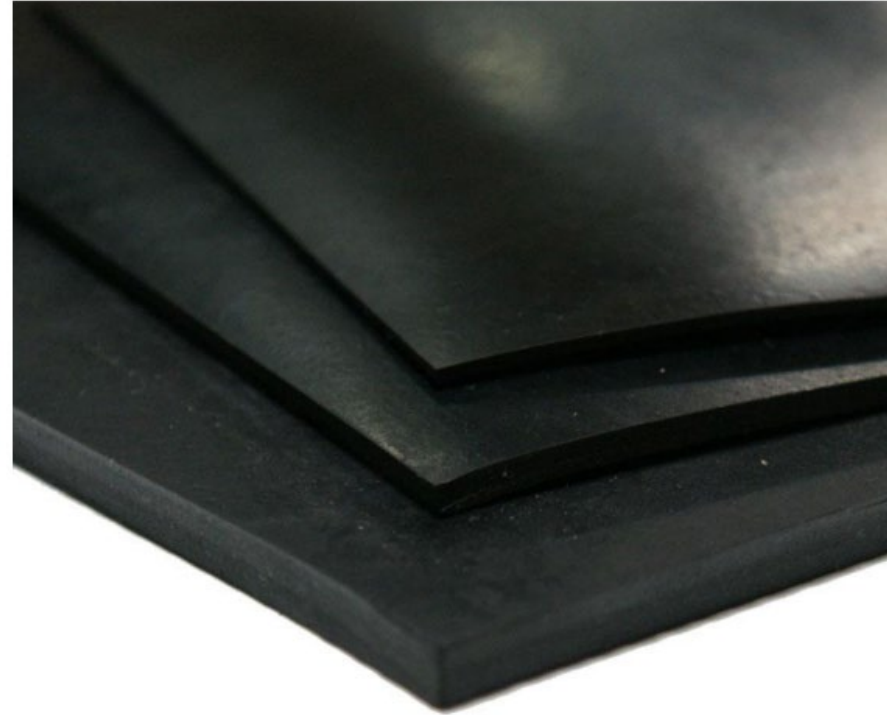
# HDPE

- Similar to wood in strength, construction, & density
- Completely waterproof & UV Stabilized
- Will not rot
- Can be easily repaired without having to be replaced.
- Can be constructed from recycled plastic and can be recycled at end of useful life.



# Neoprene Pads

- Readily available world wide
- Will provide better flexibility than wood
- Will not rot
- When bonded with steel plates top and bottom, should have an expected service life of 20 years.



# FRC

- Quicker to produce blocks
- Blocks tend to spall less, lengthening service life
- Same or better strength for same value



# Benefits

- All materials are expected to have a longer service life (expected approx. 5 times soft wood)
- All materials can be recycled at the end of their service life
- All materials are expected to have similar or better mechanical properties than current technology
- The proposed materials are new to our industry, but they are not new materials



# Cost Comparisons

- Example Case of Using HDPE or Neoprene instead of soft wood for the soft cap
- 60 Concrete blocks, topped with hard wood and a soft wood cap
- Block length = 3.5'
- Block Width = 4'
- Soft Cap = 2"
- Soft Cap Vol = 210 cu ft
- Assume 6 dockings per year
- Assume 1 hour for a crew of 3 at \$40 / hour labor



# Cost Comparisons

Description	Wood 2x4x8 Yellow Pine	HDPE 54x48x1/2 Marine Grade	Neoprene Pads
Volume per Piece (cu ft)	1.5" x 7.5" x 8' = 0.292 cu ft	54" x 48" x 1/2" = 0.75 cu ft	1 per block
Quantity	720	280	60
Unit Cost	\$3.35	\$256	\$2,538
Extended Cost (Initial Cost)	\$2,412	\$71,680	\$152,280
Labor Cost	\$7,200	\$7,200	\$7,200
Install Cost	\$9,612	\$78,880	\$159,480
% Replacement per Docking	100%	5%	2%
Annual Maintenance Cost	\$57,672	\$23,664	\$19,138
10 Year Cost	\$586,332	\$315,520	\$350,856





# Cost Comparison

- Fiber Reinforced blocks will cost approximately the same as traditional blocks.
- Expected life span 33% more than traditional reinforced blocks (15 yrs vs. 20 yrs)



# Implementation

- Going to purchased and install new materials in place of traditional materials onto test blocks at the following shipyards:
- Gulf Copper Shipyard, Port Arthur, TX
  - Testing HDPE & neoprene caps
- Navy Shipyard, San Diego, CA
  - Testing HDPE & neoprene caps
- Mare Island Dry Dock, Vallejo, CA
  - Testing fiber reinforce concrete blocks



# Testing

- Key Factors:
  - Quantify the labor involved with proposed materials and compare to traditional wood soft caps
  - Quantify the projected lifespan as compared to traditional soft wood so that the percentage replacement rate per docking can be calculated
- Take measurements of materials before & after dockings. Measurements will be compared.
- General observations to be made before and after dockings (such as rips / tears, etc.).
- Material lab will be provided control & post-docking samples for material testing.



# Deliverables

- All results will be compiled into one single, final research paper.
- Paper will contain project description, drawings, costs, photographs, lab results, etc.



# Rights & Technology Transfer

DMC acknowledges all government purpose rights of the technical data. This includes use, modification, reproduction, release, disclosure, or any other use as deemed acceptable to the federal government of the United States without technical redaction or restriction.



DMC will immediately inform the public of project award by posting information concerning the award on the DMC website and the quarterly dry dock newsletter circulated by DMC to professionals in the drydocking industry throughout the world. These same public information methods will be used for major updates throughout the project. Finally, the results of the testing will be published using the same methods as well as presented at marine industry conferences and trade shows. All technical information, research, and results will be made available for public use without restriction (See deliverables section of this document).

# Project Update

- As of the date on this report, the neoprene pads and HDPE materials have been successfully used in docking vessels. The HDPE materials have also undergone materials testing to confirm design strengths. Fiber reinforced concrete blocks have been purchased, and coring for material testing has been completed











Questions?

