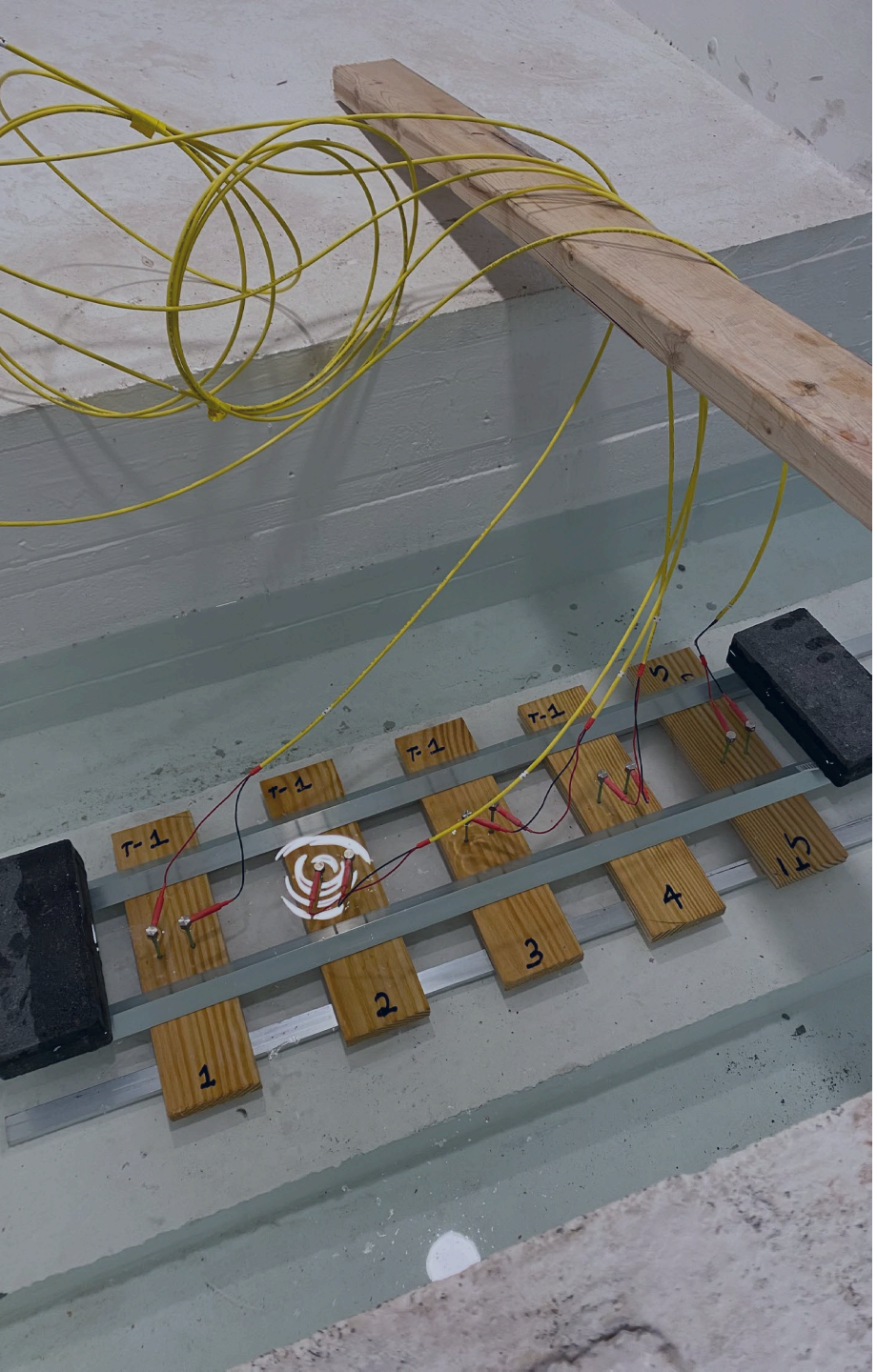

Charting Solutions in a Resilient City 2.0, Tidewater, Virginia

Portsmouth, NH
May 7-9, 2023

Museum Resources Construction & Millwork

BRS

Commonwealth Preservation Group

SESSION SPEAKERS

KERRY SHACKELFORD

- Class A Contractor & Principal, Museum Resources Construction and Millwork
- Co-owner, Building Resilient Solutions (BRS)

PAIGE POLLARD

- Principal, Commonwealth Preservation Group
- Co-owner, Building Resilient Solutions (BRS)

MUSEUM RESOURCES CONSTRUCTION & MILLWORK

BRS

COMMONWEALTH PRESERVATION GROUP

ABOUT BUILDING RESILIENT SOLUTIONS (BRS)

- Location: Suffolk, Virginia
- First lab of its kind
- Support testing alternative retrofits
- Yields thoughtful, informed solutions

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OUR WORK: 2021

Addressed issues with current codes and ordinances

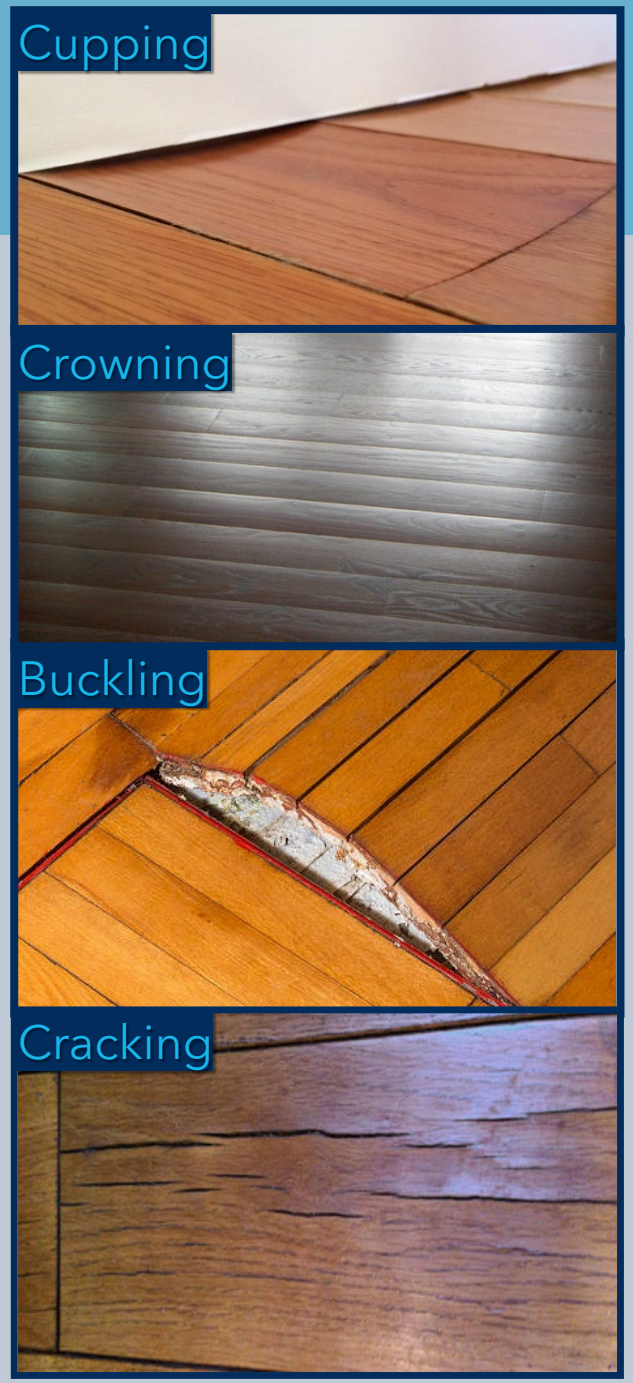
- Indiscriminate impact on properties
  - Trigger not limited to flood related events
- Loss of inherently resilient historic building materials
  - Enter permanent cycle of replacement with disposable materials
- Reduction in property values
  - Impact to real estate assessment
- No solutions for properties when elevation and demolition are too extreme given the risk

OUR WORK: 2022

Opening of our Suffolk Lab

Initial Testing Objectives

- Development of consistent assessment method durability and reuse of materials post flood event
- Establishment of damage functions for future occurrences of flooding events
- Creation of baseline for an empirical approach to develop fragility curves



TEST PROTOCOL 1.1
PURPOSE & PARTNERS

Goal

Study the durability and survivability of historic wood flooring materials that have been exposed to limited duration water inundation, as is commonly experienced during tidal flooding events

Test Partners:

NCPTT

Preservation Virginia APVA 1889

BRS

Museum Resources Construction & Millwork

Commonwealth Preservation Group

Virginia Tech

Reichard Building Science Consulting, LLC

TEST PROTOCOL 1.1 DESIGN

How? The Flood Chamber

- Can be flooded to simulate flood event
- Drained after set period of time to replicate a drying period

Data Collected

Changes occurring in wood samples:

- Width
- Thickness
- Weight
- Moisture Content

NCPTT

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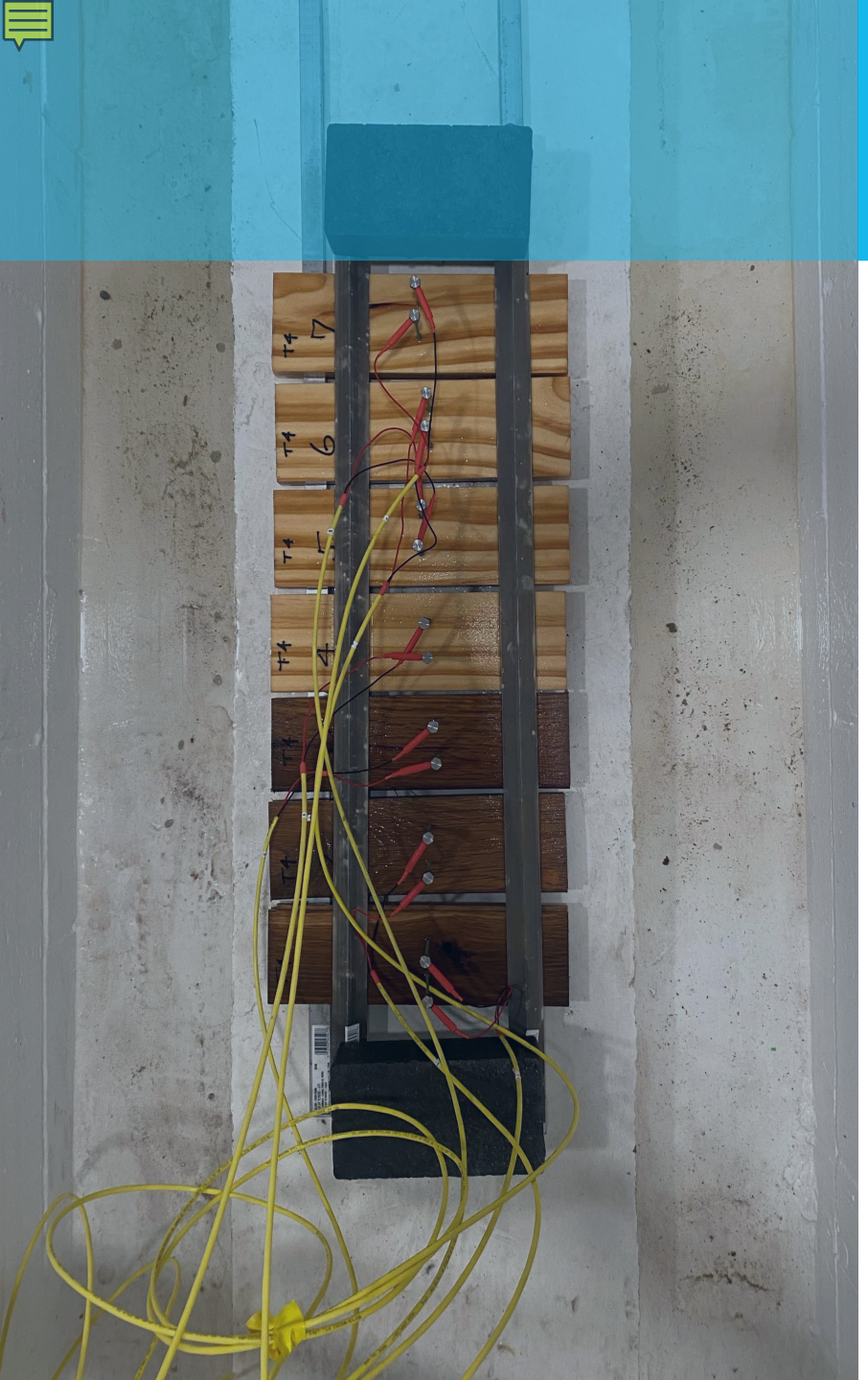

TEST PROTOCOL 1.1 DESIGN

Materials Tested

Flooring samples representative of common flooring materials in Tidewater, VA

- Pre-1970s structures
- Modern structures

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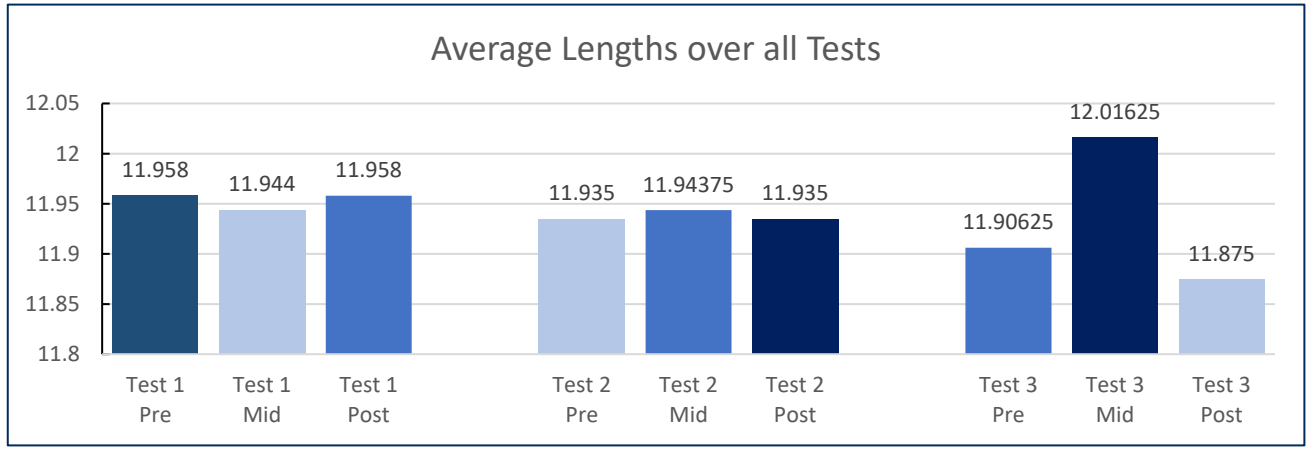
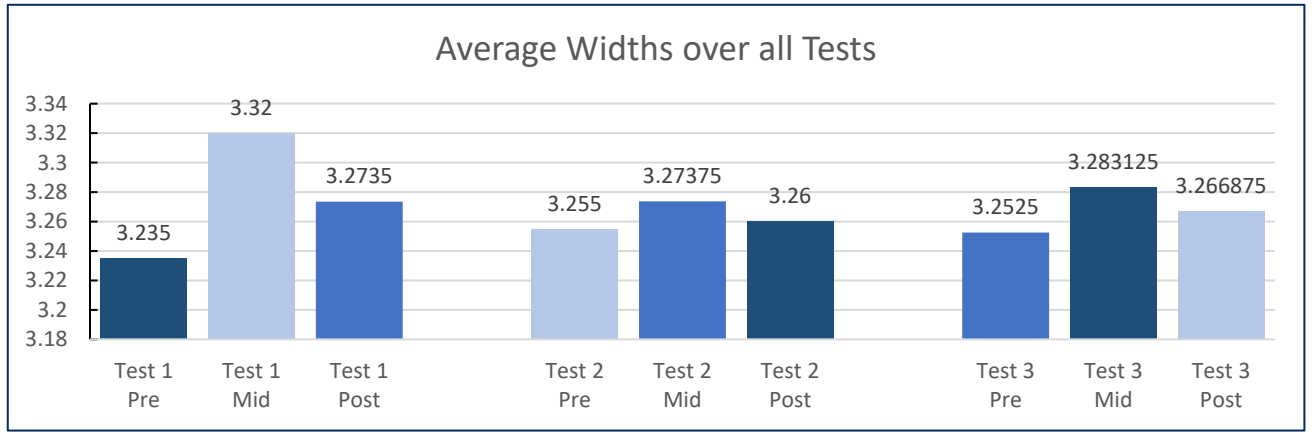
TEST PROTOCOL 1.1 DATA





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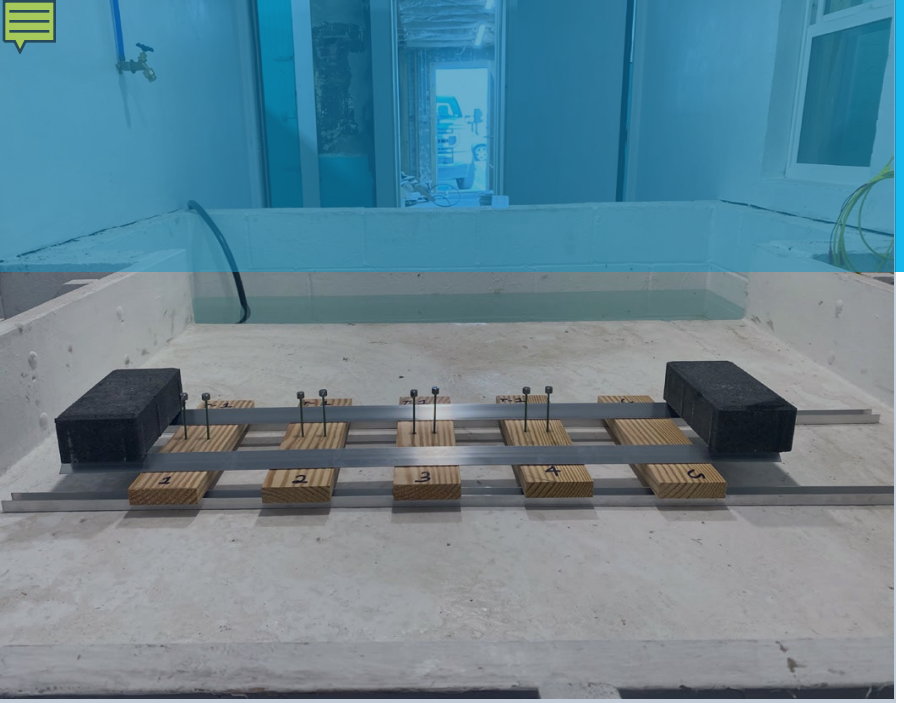

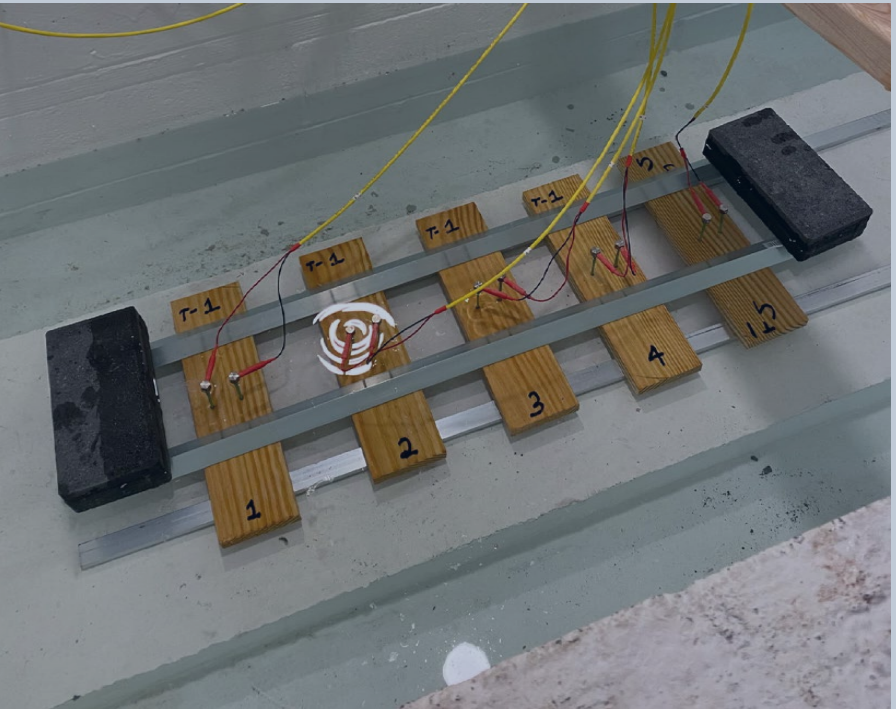

TEST PROTOCOL 1.1 TAKEAWAYS

Executive Summary Test 1.1

Conclusions

- Modern growth had little dimensional stability
- Wood commonly found in floors in pre-1970 structures generally outperformed modern low-to-moderate wood used in modern flooring

Final Takeaway

Future protocol should be developed to test post-storm recovery for flooring

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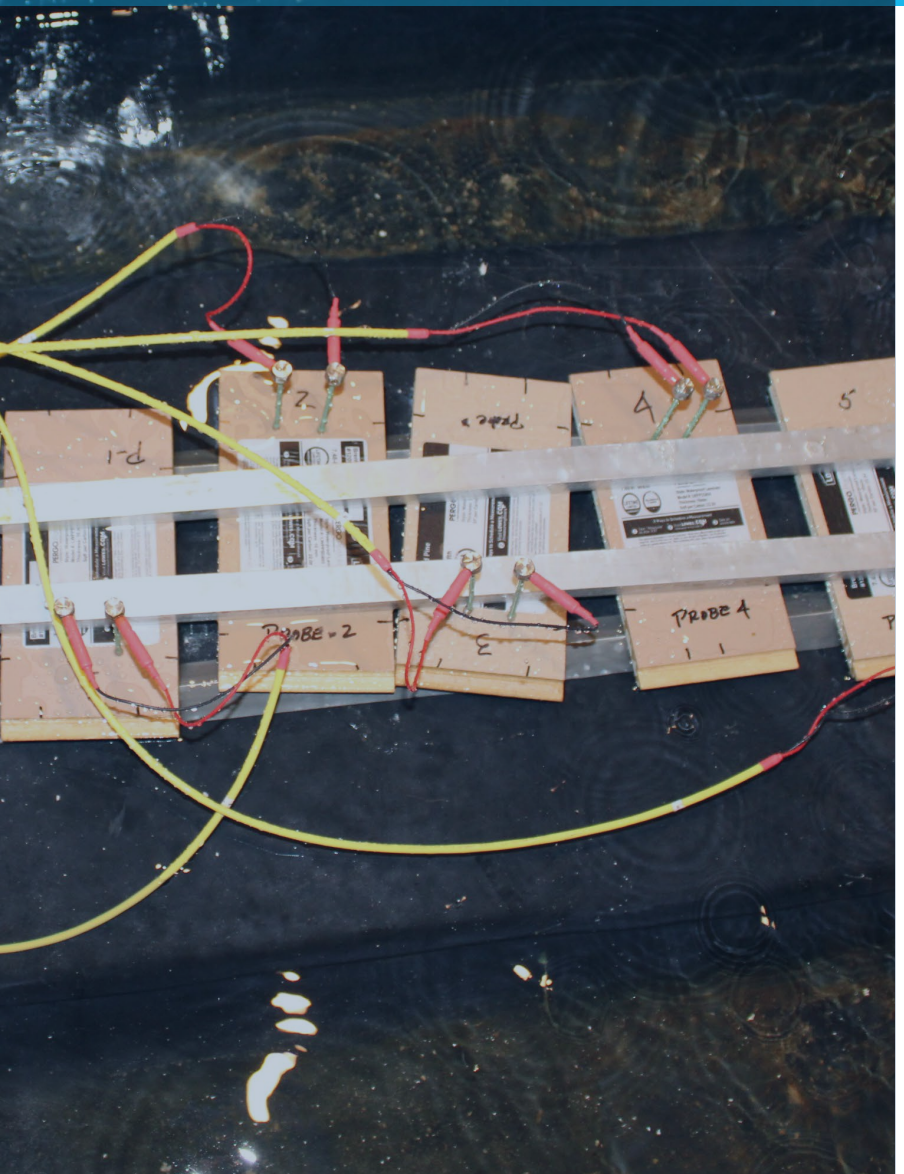
TEST PROTOCOL 1.2
PURPOSE AND PARTNERS



Goal

Study the flood resilience of engineered wood flooring materials specifically designed to survive minor flooding events

Test Partners:

City of Suffolk, Virginia

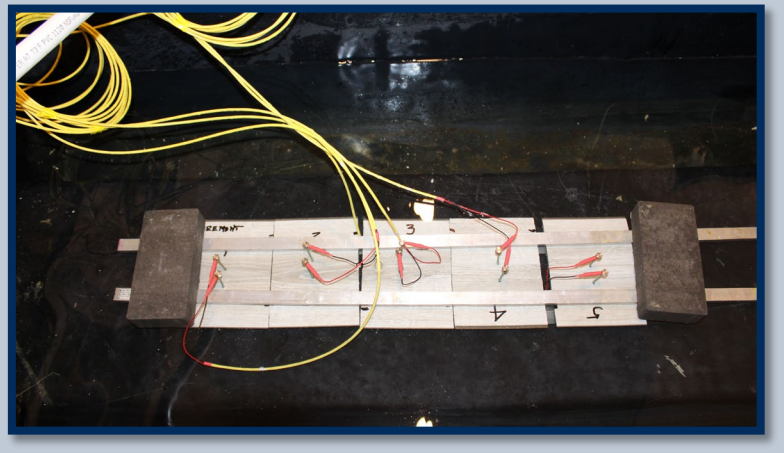
BRS

Museum Resources Construction & Millwork

Commonwealth Preservation Group

Virginia Tech

Reichard Building Science Consulting, LLC



TEST PROTOCOL 1.2 DESIGN

How? The Flood Chamber

Same conditions used for Protocol 1.1

- Made to replicate a flood event
- Drained after set period of time to replicate a drying period

Data collected

Changes occurring in samples:

- Size
- Deformations
- Moisture retention
- Appearance
- Will be compared to historic flooring

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COMMONWEALTH PRESERVATION GROUP

VIRGINIA TECH

Reichard BUILDING SCIENCE Consulting, LLC

TEST PROTOCOL 1.2 DESIGN

Materials Tested

Engineered wood flooring materials from three major retailers:

- Pergo Wet-Protect Brentwood Pine Wood Plank Laminate Flooring
- Freemont Eco Resilient Flooring
- Midtown Light Oak Wire-Brushed Engineered Hardwood

NANSEMOND 1646 SUFFOLK 1742 19 74 CITY OF SUFFOLK, VIRGINIA

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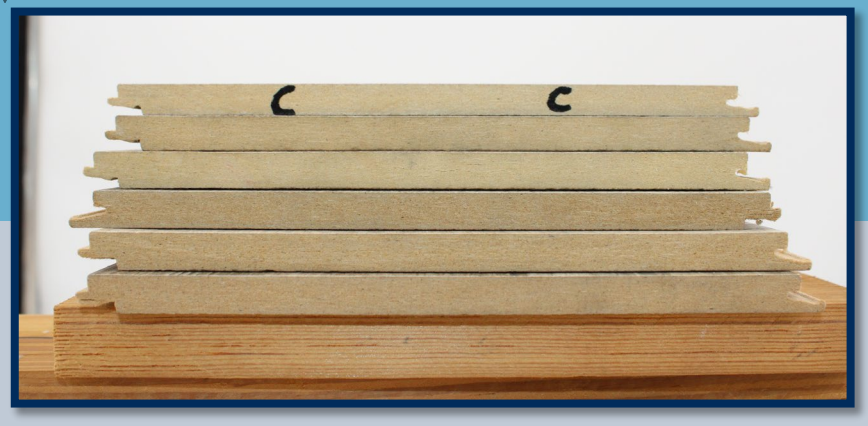
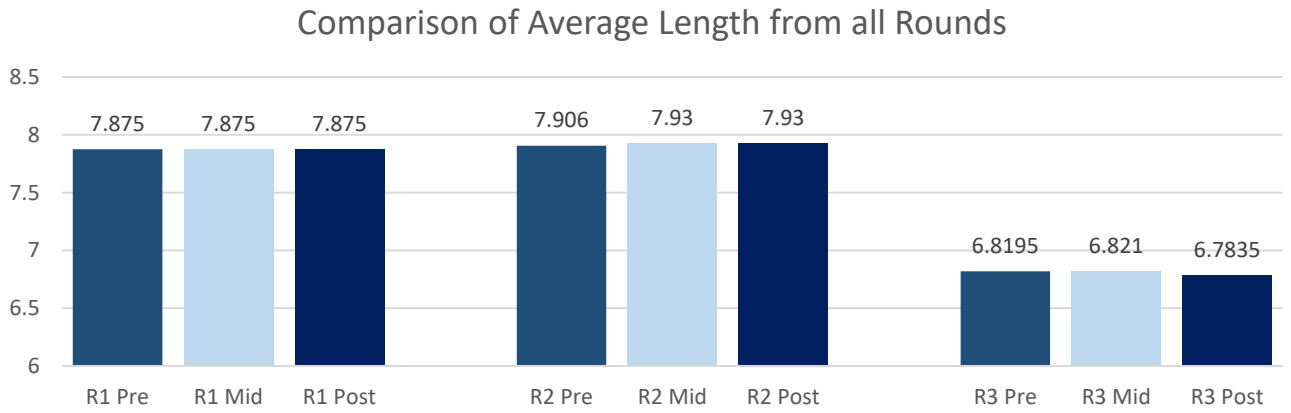
COMMONWEALTH PRESERVATION GROUP

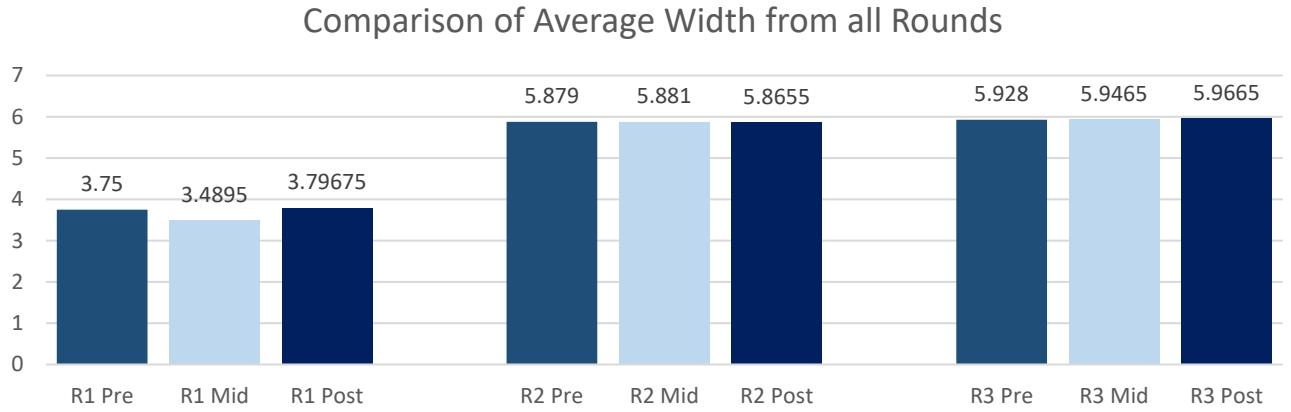
VIRGINIA TECH

Reichard BUILDING SCIENCE Consulting, LLC

TEST PROTOCOL 1.2 DATA







VIRGINIA TECH

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TEST PROTOCOL 1.2
Takeaways

Conclusions

- All engineered flooring tested exhibited dimensional instability: Samples cupped and distorted in thickness and width
- Engineered products with no wood in their composition were the most resilient of the group
  While moderately resistant to moisture the engineer products can not be repaired post flooding
- While moderately resistant to moisture, the engineered products cannot be repaired post flood event

Final Takeaway

Future testing should also include a complete floor assembly including glue down applications and nail applications

CITY of SUFFOLK, VIRGINIA

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VIRGINIA TECH

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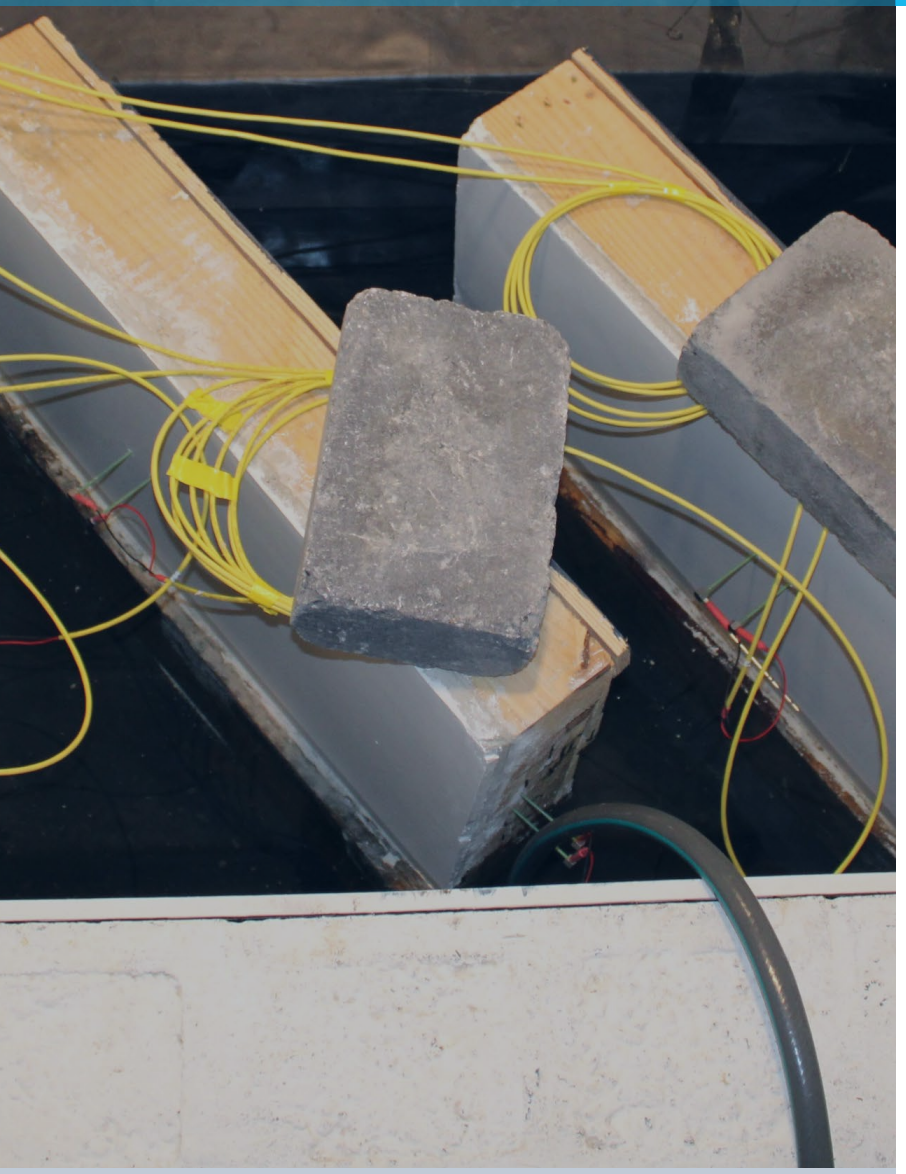
TEST PROTOCOL 2.1
PURPOSE and PARTNERS



Goal

Study the survivability of historic plaster wall assemblies and exterior cladding materials that have been exposed to limited duration water inundation, as is commonly experienced during tidal flooding events

Test Partners:

RISE Resilience Innovations

BRS

Museum Resources Construction & Millwork

Commonwealth Preservation Group

Virginia Tech

Reichard Building Science Consulting, LLC

TEST PROTOCOL 2.1 DESIGN

How? The Flood Chamber

- Made to replicate a flood event
- Can be flooded to simulate flood event
- Drained after set period of time to replicate a drying period

Data collected

Changes occurring in samples:

- Moisture content
- General observations

RISE Resilience Innovations

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Commonwealth Preservation Group

Virginia Tech

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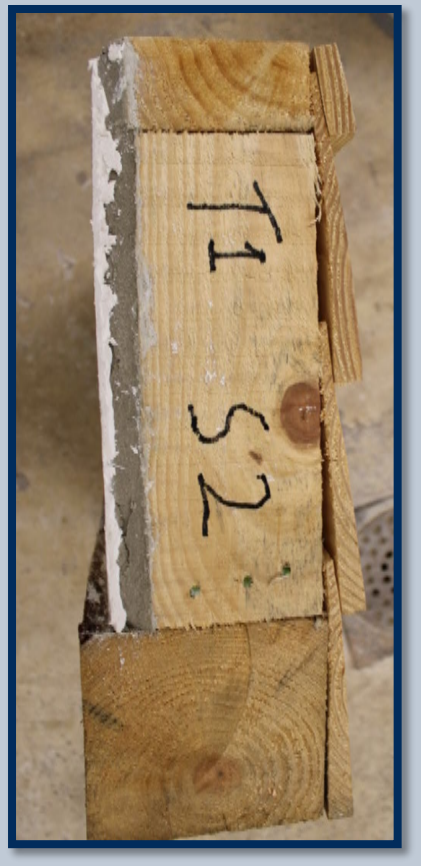
TEST PROTOCOL 2.1 DESIGN



Materials Tested

Replicated assemblies representative of common assemblies in Tidewater, VA

Samples that were used include:

- Plaster on Wood Lath with taper sawn Southern Yellow Pine Siding
- Plaster on Wire Lath with taper sawn Southern Yellow Pine Siding
- Modern Drywall with taper sawn Southern Yellow Pine Siding

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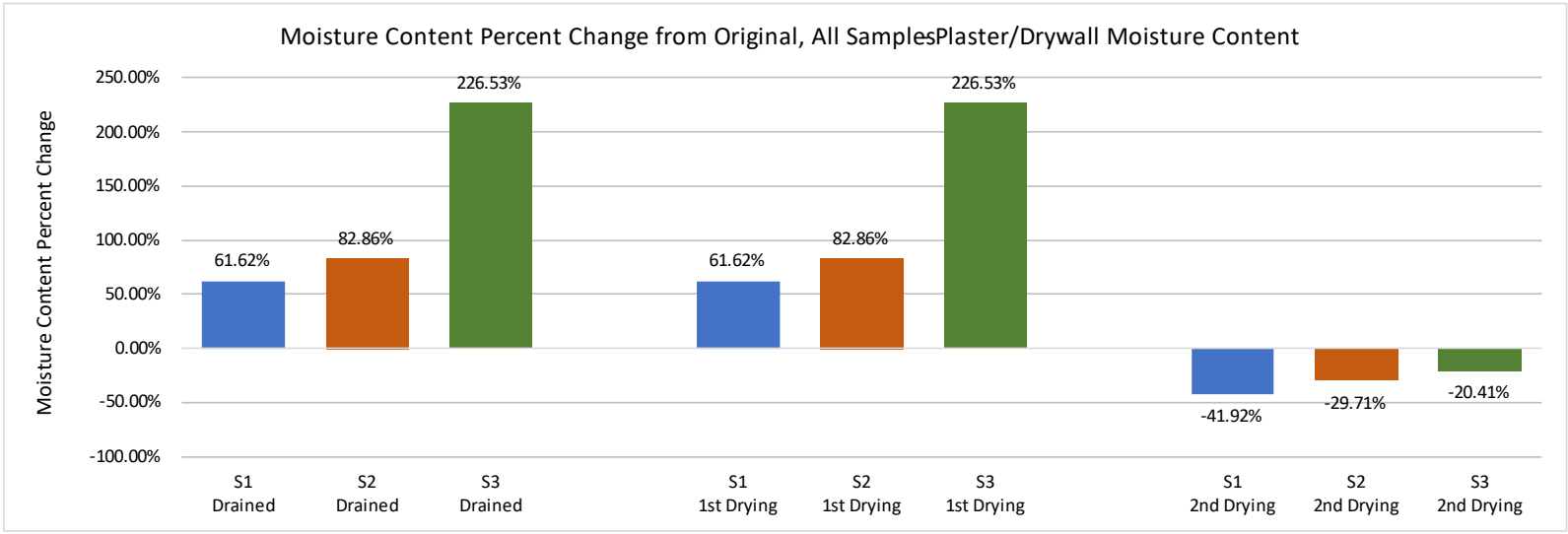
TEST PROTOCOL 2.1 DATA



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TEST PROTOCOL 2.1 Takeaways

Executive Summary Test 2.1

Conclusions

- Common wall assemblies in pre-1970 structures are highly survivable in flood scenarios.
- Plaster on wood or wire lath wall assembly are highly survivable in flood events

Final Takeaway

Future protocol should be developed to test post-storm recovery of wall assemblies

RISE Resilience Innovations

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OUR WORK: 722 FILER STREET

Background

c.1920s residence

- 1,082 SF
- 1.5 Stories

Chesterfield Heights Historic District

Family purchased 1964; first flood incident 2009

Project completed April 2023

OUR WORK: 722 FILER STREET

Project Scope

- Owner to “age in place” with ADA mobility and care considerations for parent
- Involved Flood Mitigation and Retrofit
- Use of Moisture monitoring and Building Assessment
- Received a Special Flood Hazard Area Exception Approval from Norfolk's Floodplain Ordinance

OUR WORK: 722 FILER STREET

- Regrade site
- Reinstate pier foundation and flooring system
- Install properly functioning gutters and downspouts
- Apply mold and rot resistant materials up to the DFE

OUR WORK: 722 FILER STREET

During Construction

After

- Reconfigure floorplan
- Use of rot resistant materials
  - Fibrex board drywall below Design Flood Elevation with a 3" gap Above Finished Floor
  - Rot resistant framing and trim
- Historic/heart pine replacement flooring
- Electrical run in weathertight conduit polystyrene insulation
- Capillary break at the chair rail
- Slot at top for ventilation behind crown (in addition to base)

FUTURE TESTING PRIORITIES

- Complete flooring assembly
- Systems with subfloor
- Systems without subfloor
- Nailed in place flooring
- Glued in place flooring
- Post flood event use of materials
- Biological contaminates
- Local flood waters

DISCUSSION

WHAT FUTURE TESTING WOULD YOU LIKE TO SEE?

RESOURCES AND PARTNERS

RISE
Resilience Innovations

Preservation Virginia APVA 1889

National Park Service

Nansemond 1646 Suffolk 1742 19 74 City of Suffolk, Virginia

Museum Resources Construction & Millwork

Commonwealth Preservation Group

BLSDCGI Reichard BUILDING SCIENCE Consulting, LLC

Virginia Tech

BUILDING RESILIENT SOLUTIONS
Thoughtful, informed retrofit design.

Email: admin@brs.llc
Website: https://www.brs.llc/

EXECUTIVE SUMMARIES

Executive Summary Test 1.1

Executive Summary Test 2.1