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EXECUTIVE SUMMARY - TEST 1.1

Testing the Flood Resiliency of Historic Wood Flooring Material Using Test Protocol BRS 1-22

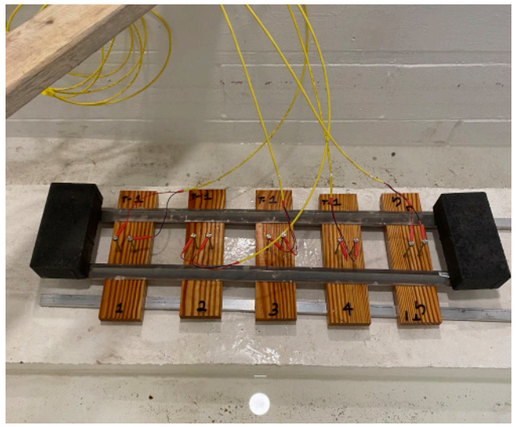
DECEMBER 2022

Testing the Flood Resiliency of Historic Wood Flooring Material was undertaken to 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. The tests were performed in accordance with "BRS 1-22: Test Protocol for Flood Testing of Wood Floors," developed by Georg Reichard, Ph.D., P.E. for BRS to create a consistent assessment method for the durability and survivability of wood floors after flooding events.

Test 1 prior to test flooding

CONCLUSIONS & FUTURE TESTING

In general, the results of this test indicate that a floor system laid from dense, old growth Southern Yellow Pine, like many of the floors found in pre-1970 structures in the Tidewater region of Virginia, will outperform a floor system laid from modern low-to-moderate density Southern Yellow Pine or White Oak. The old growth Southern Yellow Pine floors can and will survive a flood event with little repair or replacement. Further testing will help us build a protocol for post-storm recovery for flooring materials which show high rates of survivability.



Test 1 specimens after draining

ABOUT BUILDING RESILIENT SOLUTIONS:

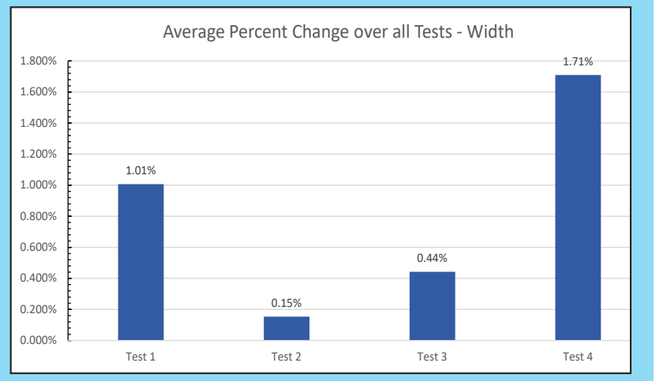
Building Resilient Solutions (BRS) is a joint venture between Commonwealth Preservation Group (CPG) and Museum Resources Construction and Millwork (MRCM) that was formed to address the growing number of existing buildings that are vulnerable to damage from recurrent flooding. Through a combination of field monitoring equipment, data collection, lab testing, and experience, the BRS team is dedicated to analyzing the flood resiliency of building materials and systems in pre-1970s buildings in the Tidewater region of Virginia and providing on-site monitoring and retrofit designs for individual properties. In 2022, BRS opened the first research laboratory in the United States dedicated to testing the flood resiliency of building materials and systems. The BRS lab includes an enclosed flood test chamber that allows for controlled, repeatable testing of building materials and assemblies, which in turn provide the opportunity for analysis and retrofit testing.

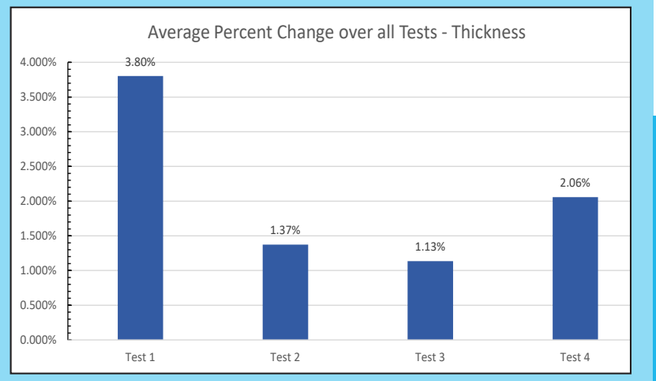
COMPARATIVE RESULTS ACROSS TESTS 1-4

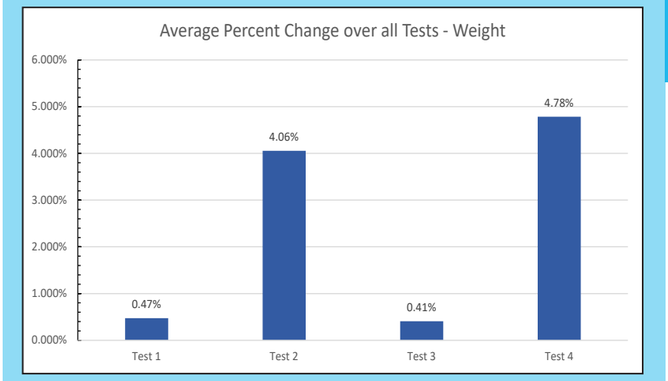
The graphs to the right illustrate the average percent change between pre-wetting and post-drying width, thickness, and weight measurements for each of the four tests performed in this test. The percentages shown are the averages of the percent change measurements for each sample within a test. Tests included the following sample specimens:

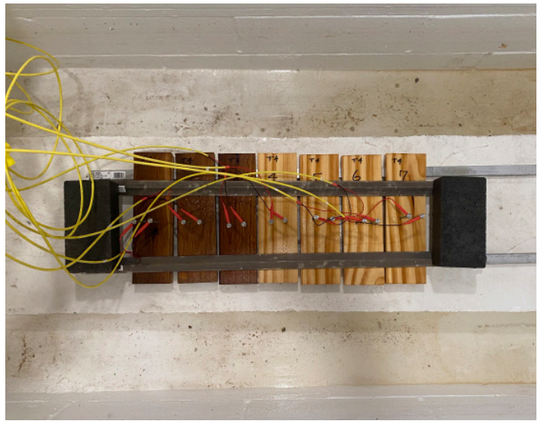
- Test 1: Modern Southern Yellow Pine (5 pieces)
- Test 2: Old Growth Southern Yellow Pine, Rift Sawn (5 pieces)
- Test 3: Old Growth Southern Yellow Pine, Flat Sawn (4 pieces)
- Test 4: Modern White Oak & Modern Southern Yellow Pine (3 pieces & 4 pieces respectively)

These changes were measured with digital calipers and a bench scale to ensure accuracy and consistency in measurement output.







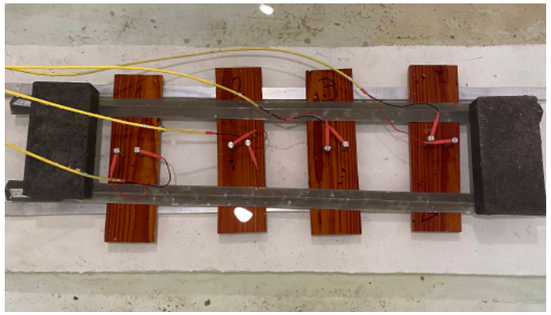

Test 4 specimens after drawing

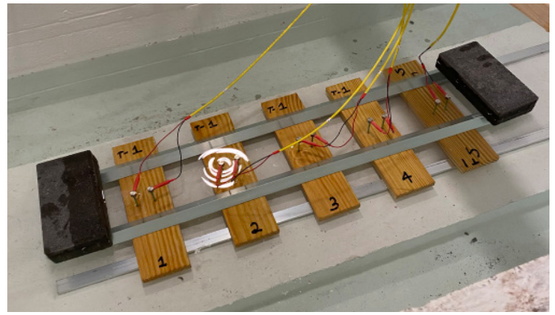
This Protocol, specifically, was intended to replicate flood events and drying periods typical to the conditions seen in Tidewater, Virginia to analyze their effects on species of old and modern growth wood commonly used in finished flooring. Samples were submerged in treated tap water for 72 hours and allowed to dry for 7 days. Moisture content was monitored throughout testing with an installed probe system. Specific length, width, thickness, weight and moisture content (with pinless meter) measurements were taken 3 times: immediately before inundation, after the test chamber was drained, and after the 7 day drying period. The consistent testing methods and observations made during this testing allow for an assessment of the survivability of historic wood materials in a replicable fashion for evaluation of performance during and immediately after a flood event.

Precise measurements taken before and after testing

KEY FINDINGS

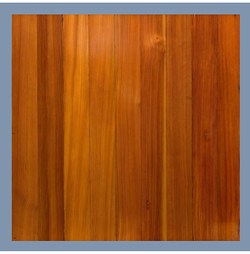
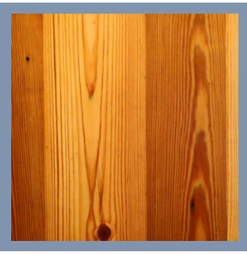
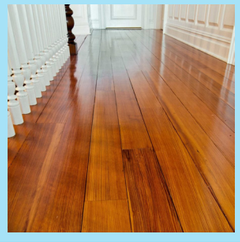
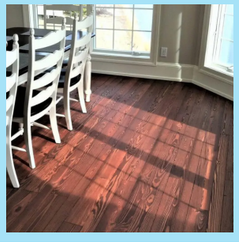
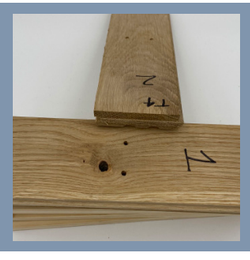
- Modern growth Pine samples exhibited little dimensional stability, which when nailed in place would cause the floor to buckle and fasteners to fail, even on rift sawn samples.
- Modern White Oak samples exhibited similar changes that would cause much of the same damage as modern Pine.
- Dense growth Pine samples exhibited the smallest expansion in width.
- Overall, the dense growth Pine outperformed the low-density Pine during both wet and dry conditions for all categories except thickness.
- There is a direct correlation between weight gain and water absorption; this gain manifests in significantly increased width and nominally increased thickness.


Old Growth, Southern Yellow Pine specimens during flooding


Modern Southern Yellow Pine specimens during flooding

WOOD SAMPLES USED IN TESTING

Samples were chosen to represent some of the most common flooring materials utilized in pre-1970 structures in the Tidewater area of Virginia, as well as the modern materials that replaced them in later construction. Specimens tested included:

WOOD TYPE	SAMPLE #1 MODERN SOUTHERN YELLOW PINE	SAMPLE #2 OLD GROWTH SOUTHERN YELLOW PINE, RIFT SAWN	SAMPLE #3 OLD GROWTH SOUTHERN YELLOW PINE, FLAT SAWN	SAMPLE #4 MODERN WHITE OAK
DETAIL EXAMPLE				
ROOM EXAMPLE				
TEST EXAMPLE				

BRS's inaugural test, Protocol 1: *Testing the Flood Resiliency of Historic Wood Flooring Material Using Test Protocol BRS1-22*, was made possible through a partnership with Preservation Virginia and funded through a grant to them by the National Parks Service and the National Center for Preservation Technology and Training.

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