

**INVESTIGATION OF BOND STRENGTH AND WATERTIGHTNESS  
OF ASPHALT CONCRETE WEARING SURFACES FOR TIMBER  
BRIDGE DECKS**

by

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(ABSTRACT)

Two different asphalt concrete systems were examined in this research study. The existing system, consistent with current timber bridge construction practice, uses a preformed waterproofing membrane placed on a preservative treated wood deck overlaid with a bituminous concrete wearing surface. The second system consists of a treated wood deck overlaid with a base course of bituminous concrete, a waterproofing membrane, and a bituminous concrete wearing surface.

The testing regime used in this research to evaluate watertightness and bond performance incorporated three parameters: three waterproofing membranes, two wood preservative treatments, and two environmental degradation conditions induced by temperature cycling in a moisture saturated condition. Control groups were evaluated for each study parameter and duplicate specimens were prepared and tested for each of the study parameters. A total of 160 specimens were constructed and tested.

Watertightness of each system was determined by measuring the electrical impedance across a test specimen perpendicular to the direction of bond orientation in the pavement. The bond strength between each material of the paving systems was assessed using a shear test apparatus designed and built for this study.

In addition to the laboratory constructed specimens, three drilled cores were taken from a bridge located on Creekside Drive in East Pennsboro Township, Pennsylvania. The deck was constructed using the new design proposed in this research and each core was tested for watertightness and bond strength.

Results of watertightness testing indicated that low temperature environments appear to be most detrimental to system integrity in both the existing and proposed paving system configurations examined in this research. In general, each membrane appeared to perform equally well in the proposed paving system configuration as well as with all of the wood preservative treatments used in the existing pavement system.

Bond strength between asphalt and wood with no membrane was observed to be nonexistent whether or not any preservative treatment was present. The placement of a membrane between these two layers did, however, result in a significant increase in bond strength because each membrane tested was able to adhere to the wood base better than the asphalt overlay. This gain in strength was significantly offset when petroleum solvent based preservative treatments were present in the wood substrate. Protectowrap M400 membrane performed slightly better than the other membranes when used with untreated wood, but all of the membranes performed equally when preservative treatments were present. The highest interlayer bond strengths (asphalt/asphalt or asphalt/wood) observed in this research occurred when asphalt concrete surface material was placed directly on top of asphalt concrete base material, however the addition of a membrane between the asphalt lifts consistently reduced this strength. The results of bond testing indicate that the proposed system will perform better in terms of shoving in the pavement overlay. Based on bond test results of cores taken from the Creekside Drive bridge, it appears that a shear strength greater than 25 psi after 200 low temperature exposure cycles will provide acceptable paving system performance in a low temperature (0-40°F) environment.

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## TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGMENTS	iv
LIST OF FIGURES	vii
LIST OF TABLES	xi
CHAPTER I. INTRODUCTION	
1.1 Background	1
1.2 Literature Review	
1.2.1 Background	2
1.2.2 Membrane Classification	3
1.2.3 Waterproofing System Components	5
1.2.4 Waterproofing System Performance on Concrete Bridge Decks	7
1.2.5 Wooden Bridge Decks	8
1.3 Objective and Scope	9
CHAPTER II. RESEARCH METHODS AND MATERIALS	
2.1 Evaluation of Waterproofing Systems	10
2.2 Specimen Design and Materials	13
2.2.1 Specimen Construction	16
2.2.2 Wood Preparation	16
2.2.3 Membrane Preparation	18
2.2.4 Assembly and Compaction of Specimens	18
2.2.5 Edge Seal and Ponding Dam	19
2.3 Obtaining Creekside Drive Bridge Deck Cores	20
2.4 Environmental Degradation Exposure Cycling	20
2.5 Watertightness Test and Procedures	22
2.6 System Bond Test and Procedures	22
CHAPTER III. RESULTS, ANALYSIS, AND DISCUSSION	
3.1 Watertightness Testing	26
3.1.1 Existing Waterproof Paving System	26
3.1.2 Proposed Waterproof Paving System	32
3.2 System Bond Testing	33
3.3 Creekside Drive Bridge Cores	34



CHAPTER IV. CONCLUSIONS	
4.1 Conclusions	45
CHAPTER V. RECOMMENDATIONS	
5.1 Recommendations	46
5.2 Future Research Needs	46
REFERENCES	47
APPENDIX A	49
Assay Results and Treatment Parameters for Treated Wood Used in Laboratory Constructed Specimens	
APPENDIX B	54
Designs for Virginia Department of Transportation Asphalt Mixtures SM-2AL and BM-2	
APPENDIX C	56
Analysis of Asphalt Mixtures by the Virginia Transportation Research Council	
APPENDIX D	62
Physical Property Measurements and Load-Strain Data for Membranes Used in Laboratory Constructed Specimens	
APPENDIX E	68
Fabrication Drawings for Bond Strength Test Apparatus	
APPENDIX F	81
Specimen Numbering Scheme	82
Impedance, Moisture Content, Shear Strength, and Failure Mode Data	83
APPENDIX G	87
Impedance and Moisture Content Bar Charts	
APPENDIX H	99
Shear Failure Mode Diagram	100
Shear Strength Bar Charts	101
VITA	105

## LIST OF FIGURES

Figure-1.1	Sheet Waterproofing Systems	3
Figure-1.2	Liquid Waterproofing Systems	5
Figure-2.1	Existing Timber Bridge Pavement Configuration	10
Figure-2.2	Proposed Timber Bridge Pavement Configuration	11
Figure-2.3	Test Matrix for Laboratory Constructed Specimens	12
Figure-2.4	Lab Constructed Test Specimen	13
Figure-2.5	Drill Press and Hole Saw Used to Obtain Wood Cylinder Substrates	17
Figure-2.6	Membrane Punch	17
Figure-2.7	Specimen Edge Seal and Ponding Dam	19
Figure-2.8	Bridge Core Locations	21
Figure-2.9	Water Cooled Core Saw Setup on Creekside Drive Bridge	21
Figure-2.10	Low-Temperature Cycling Chamber	23
Figure-2.11	High-Temperature Cycling Chamber	23
Figure-2.12	Impedance Test Apparatus	24
Figure-2.13	Bond Test Apparatus	25
Figure-3.1	Shear Strengths for Existing Waterproof Paving System (Untreated Wood Base/Membrane/SM-2 Surface Asphalt Mixture)	36
Figure-3.2	Shear Strengths for Existing Waterproof Paving System (Creosote Treated Wood Base/Membrane/SM-2 Surface Asphalt Mixture)	37

Figure-3.3	Shear Strengths for Existing Waterproof Paving System (Pentachlorophenol Treated Wood Base/Membrane/ SM-2 Surface Asphalt Mixture)	38
Figure-3.4	Shear Strengths for Proposed Waterproof Paving System (BM-2 Base Asphalt Mixture/Membrane/SM-2 Surface Asphalt Mixture)	39
Figure-3.5	Typical Load-Deflection Plot for Specimens made with an Untreated Wood Substrate and a Membrane	40
Figure-3.6	Typical Load-Deflection Plot for Specimens made with a Treated Wood Substrate and a Membrane	41
Figure-3.7	Typical Load-Deflection Plot for Specimens made with an Asphalt Substrate and No Membrane	42
Figure-3.8	Typical Load-Deflection Plot for Specimens made with an Asphalt Substrate and a Membrane	43
Figure-3.9	Shear Strengths for Creekside Drive Bridge Cores	44
Figure-C.1	Surface Mix Gradations	58
Figure-C.2	Base Mix Gradations	58
Figure-D.1	Locations of Membrane Thickness Measurements	64
Figure-E.1	Complete Test Fixture Assembly, Side View	69
Figure-E.2	Complete Test Fixture Assembly, Plan View	70
Figure-E.3	Complete Test Fixture Assembly, Section A	71
Figure-E.4	Complete Test Fixture Assembly, Section B	72
Figure-E.5	Complete Test Fixture Assembly, Section C	73
Figure-E.6	Complete Test Fixture Assembly, Section D	74
Figure-E.7	Specimen Holder Fixed Base	75
Figure-E.8	Specimen Holder Loading Base	76



Figure-E.9	Specimen Holder Adjustable Clamp	77
Figure-E.10	Teflon Guide Plates	78
Figure-E.11	Loading Block	79
Figure-E.12	Specimen Shims	80
Figure-F.1	Bond and Watertightness Testing Specimen Numbering Scheme	82
Figure-G.1	Impedance Measurements for Existing Waterproof Paving System (Untreated Wood Base/Membrane/SM-2 Asphalt Mixture) in High Temperature Cycling Exposure Environment	88
Figure-G.2	Impedance Measurements for Existing Waterproof Paving System (Creosote Treated Wood Base/Membrane/SM-2 Asphalt Mixture) in High Temperature Cycling Exposure Environment	89
Figure-G.3	Impedance Measurements for Existing Waterproof Paving System (Pentachlorophenol Treated Wood Base/Membrane/SM-2 Asphalt Mixture) in High Temperature Cycling Exposure Environment	90
Figure-G.4	Impedance Measurements for Existing Waterproof Paving System (Untreated Wood Base/Membrane/SM-2 Asphalt Mixture) in Low Temperature Cycling Exposure Environment	91
Figure-G.5	Impedance Measurements for Existing Waterproof Paving System (Creosote Treated Wood Base/Membrane/SM-2 Asphalt Mixture) in Low Temperature Cycling Exposure Environment	92
Figure-G.6	Impedance Measurements for Existing Waterproof Paving System (Pentachlorophenol Treated Wood Base/Membrane/SM-2 Asphalt Mixture) in Low Temperature Cycling Exposure Environment	93

Figure-G.7	Impedance Measurements for Proposed Waterproof Paving System (BM-2 Base Asphalt Mixture/Membrane/SM-2 Asphalt Mixture) in High Temperature Cycling Exposure Environment	94
Figure-G.8	Impedance Measurements for Proposed Waterproof Paving System (BM-2 Base Asphalt Mixture/Membrane/SM-2 Asphalt Mixture) in Low Temperature Cycling Exposure Environment	95
Figure-G.9	Wood Moisture Content Measurements for Existing Waterproof Paving System (Untreated Wood Base/Membrane/SM-2 Asphalt Mixture)	96
Figure-G.10	Wood Moisture Content Measurements for Existing Waterproof Paving System (Creosote Treated Wood Base/Membrane/SM-2 Asphalt Mixture)	97
Figure-G.11	Wood Moisture Content Measurements for Existing Waterproof Paving System (Pentachlorophenol Treated Wood Base/Membrane/SM-2 Asphalt Mixture)	98
Figure-H.1	Failure Mode Diagram	100
Figure-H.2	Shear Strengths for Existing Waterproof Paving System (Untreated Wood Base/Membrane/SM-2 Asphalt Mixture)	101
Figure-H.3	Shear Strengths for Existing Waterproof Paving System (Creosote Treated Wood Base/Membrane/SM-2 Asphalt Mixture)	102
Figure-H.4	Shear Strengths for Existing Waterproof Paving System (Pentachlorophenol Treated Wood Base/Membrane/SM-2 Asphalt Mixture)	103
Figure-H.5	Shear Strengths for Proposed Waterproof Paving System (BM-2 Base Asphalt Mixture/Membrane/SM-2 Asphalt Mixture)	104

## LIST OF TABLES

Table-1.1	Characteristics of Sheet and Liquid Membrane Systems	4
Table-1.2	Requirements for Waterproofing Systems	7
Table-2.1	Measured Dimensional Properties and Physical Observations for Membranes	15
Table-2.2	Summary of Load-Strain Properties for Membranes	16
Table-2.3	Asphalt Lift Thicknesses for Creekside Drive Bridge Core Samples	20
Table-3.1	Impedance and Shear Data for Creekside Drive Bridge Core Samples	35
Table-A.1	Treatment Parameters Used in Small Cylinder for Test	51
Table-A.2	Visual Inspection and Weight Difference Retention Data	52
Table-B.1	Aggregate Retention Specification for Asphalt Concrete Mixtures	55
Table-B.2	Mixture Design Criteria for Asphalt Concrete Mixtures	55
Table-C.1	Asphalt Content and Gradation of Test Mixtures	57
Table-C.2	Volumetric Properties	60
Table-C.3	SUPERPAVE Volumetric Criteria	60
Table-C.4	Total Resilient Modulus Data	61
Table-D.1	Physical Property Measurements for Bituthene 5000 Membrane	63
Table-D.2	Physical Property Measurements for Petrotac Membrane	63
Table-D.3	Physical Property Measurements for Protectowrap M400A Membrane	63

Table-D.4	Load-Strain Data for Bituthene 5000 Membrane	65
Table-D.5	Load-Strain Data for Petrotac Membrane	66
Table-D.6	Load-Strain Data for Protectowrap M400A Membrane	67
Table-F.1	Test Data for Untreated Wood Substrate Specimens	83
Table-F.2	Test Data for Creosote Treated Wood Substrate Specimens	84
Table-F.3	Test Data for Pentachlorophenol Treated Wood Substrate Specimens	85
Table-F.4	Test Data for Asphalt Substrate Specimens	86