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 (0-40ºF) 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

Assay Results and Treatment Parameters for Treated Wood Used in Laboratory Constructed Specimens 49

### APPENDIX B

Designs for Virginia Department of Transportation Asphalt Mixtures SM-2AL and BM-2 54

### APPENDIX C

Analysis of Asphalt Mixtures by the Virginia Transportation Research Council 56

### APPENDIX D

Physical Property Measurements and Load-Strain Data for Membranes Used in Laboratory Constructed Specimens 62

### APPENDIX E

Fabrication Drawings for Bond Strength Test Apparatus 68

### APPENDIX F

Specimen Numbering Scheme 81
Impedance, Moisture Content, Shear Strength, and Failure Mode Data 82

### APPENDIX G

Impedance and Moisture Content Bar Charts 87

### APPENDIX H

Shear Failure Mode Diagram 99
Shear Strength Bar Charts 100

### 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

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

Figure-G.9  Wood Moisture Content Measurements for Existing Waterproof Paving System (Untreated Wood Base/Membrane/SM-2 Asphalt Mixture)

Figure-G.10 Wood Moisture Content Measurements for Existing Waterproof Paving System (Creosote Treated Wood Base/Membrane/SM-2 Asphalt Mixture)

Figure-G.11 Wood Moisture Content Measurements for Existing Waterproof Paving System (Pentachlorophenol Treated Wood Base/Membrane/SM-2 Asphalt Mixture)

Figure-H.1  Failure Mode Diagram

Figure-H.2  Shear Strengths for Existing Waterproof Paving System (Untreated Wood Base/Membrane/SM-2 Asphalt Mixture)

Figure-H.3  Shear Strengths for Existing Waterproof Paving System (Creosote Treated Wood Base/Membrane/SM-2 Asphalt Mixture)

Figure-H.4  Shear Strengths for Existing Waterproof Paving System (Pentachlorophenol Treated Wood Base/Membrane/SM-2 Asphalt Mixture)

Figure-H.5  Shear Strengths for Proposed Waterproof Paving System (BM-2 Base Asphalt Mixture/Membrane/SM-2 Asphalt Mixture)
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 |