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 is 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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