EVALUATION OF BOND STRENGTH BETWEEN HOT MIX ASPHALT SURFACING LAYERS

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To my beloved father and mother

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ABSTRACT

This paper investigates the effect of tack coat types, application rates, and layer thickness on HMA interface shear strength. The performance of tack coat materials on AC 10 was evaluated. Three emulsions were selected as tack coat material which are RS-1K, RS-2K, and RS-2KL.These tack coat materials were applied at three application rates, namely 0.25 l/m^2, 0.40 l/m^2, and 0.55 l/m^2. The selected application rates are in accordance with the JKR specification and represents low, medium and high rates respectively Three different surface thickness were considered namely 35 mm, 50 mm and 65 mm. Only laboratory scale specimens at three replicates for each test configuration were used throughout the study. Direct shear test were carried out shearing rate of 1 mm/min. Results show modified emulsion can provide better shear strength than conventional emulsion where RS-2KL performs better than RS-1K and RS-2K due to the present of latex in RS-2KL which relate to the viscosity that can improve shear strength. On the other hand, higher thickness of wearing course and application rate can provide higher interfaces shear strength. However, their relationships were not strong due to inconsistency of R^2 values.

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ABSTRAK

Kajian ini dijalankan untuk menilai pengaruh salut jelujur, kadar aplikasi, dan ketebalan lapisan terhadap kekuatan ikatan antara permukaan. Sebanyak tiga jenis bahan salut jelujur telah digunakan, iaitu RS-1K, RS-2K dan RS-2KL. Ketiga-tiga bahan ini digunakan pada tiga kadar aplikasi yang berbeza, 0.25 l/m^2, 0.40 l/m^2 and 0.55 l/m dan tiga kadar aplikasi tersebut mewakili kadar aplikasi rendah, sederhana dan tinggi mengikut spesifikasi JKR. Ujian ricih dijalankan pada ricih 1 mm/min. Analisis yang diperolehi menunjukkan kekuatan ricih antara permukaan lapisan meningkat apabila ketebalan lapisan and kadar aplikasi meningkat. Selain itu, keputusan menunjukkan emulsi diubahsuai boleh memberikan kekuatan ricih yang lebih baik daripada emulsi konvensional di mana RS-2KL melakukan lebih baik daripada RS-1K dan RS-2K kerana kewujudan lateks pada RS-2KL yang berkaitan dengan kelikatan yang boleh meningkatkan kekuatan ricih. Walau bagaimanapun, hubungan mereka tidak kuat kerana nilai R^2 diperolehi tidak konsisten.

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CHAPTER 1

INTRODUCTION

1.1 Overview

Modern asphalt pavements are characterized by a composition of several layers. This is true for new pavements as well as for existing pavements following overlay procedures (Tschegg et al., 1995). Adequate bond between layers ensures multiple layers perform as a composite structure. As a result, stresses from applied loads are distributed throughout, subsequently reducing overall pavement damage (Buchanan and Woods, 2004). Poor interlayer bond of hot mix asphalt (HMA) is the factor of many pavement problems. Slippage failure often occur at locations where traffic accelerates, decelerates, or turns, is the most commonly observed problem related to poor bond between layers (West et al., 2005).

Tack coat is an application of asphalt binder used to improve bonding between pavement layers and it is most commonly used between an existing surface and a newly constructed overlay.It is used to ensure adequate bond between the pavement being placed and the existing surface. A tack coat provides necessary bonding between pavement layers to ensure that they behave as a single system to withstand traffic and environmental stresses. Tack coat is normally applied to an existing pavement surface before a new layer of asphalt concrete is placed. It may also be applied to the surface of a new hot mix asphalt (HMA) pavement layer before the next layer is placed, such as between an HMA levelling course and an HMA surface course (Louay et al., 2012).

The most commonly used tack coat material is asphalt emulsion followed by paving grade asphalt and cutback asphalt. Asphalt emulsion is favoured due to the simplicity of being capable to be applied at lower temperature and relatively pollution free. In some places, paving grade asphalt and cutback asphalt is still in used, but the usage of cutback asphalt as tack coat has been restricted due to issues related with environmental concern.

1.2 Problem Statement

Interface bonding has always been a major concern in pavement structures. Loss of bonding or poor bonding between pavement layers can cause early pavement distresses. Slippage failure occurs when there is insufficient bond between the interfaces of the two layers in contact. At location where vehicle is likely to exert high horizontal force, sharp curves and busy junction of continuous acceleration and deceleration, slippage failures may be frequently encountered as well (Romanoschi et al. 2001). On the other hand, delamination and potholes can be considered as one of the most common types of pavement distress related to poor bonding in Malaysia, though slippage failure can be occasionally found.

Tack coat is intended to bond pavement layers together and ensure that the layers act monolithically when subjected to traffic loads. Insufficient or improper application of tack coat can result in a weak bond between HMA pavement layers, causing the layers to act independently. Hence, an optimum tack coat application rate needs to be determined. That is the interest of this research to be carried out in order to solve and improve on the problems related to bond between hot mix asphalt layer interfaces.

1.3 Aim

The aim for this study is to evaluate the performance of bond strength on HMA surfacing layer.

1.4 Objectives

To determine the effect of tack coat types, application rates, and layer thickness on HMA interface bond strength.

1.5 Scope

The performance of tack coat materials on AC10 was evaluated. A total of three tack coat materials, which include three emulsions, RS-1K, RS-2K, and RS-2KL were selected. These tack coat materials was applied at three application rates, which is 0.25 l/m², 0.40 l/m², and 0.55 l/m². The selected application rates are in accordance with the JKR specification and represents low, medium and high rates respectively. Three different wearing course layer thickness were considered namely 35mm, 50mm and 65mm. Only laboratory scale specimens at three replicates for each test configuration are used throughout the study. Direct shear test was carried out at shearing rate of 1mm/min.

1.6 Thesis Structure

The thesis has been categorized into specific chapters for better understanding of the research. The lists of chapters are as follow:

Chapter 1: Introduction – This chapter gives an overview of the thesis including five important things such as overview of the study, problem definition, objective of the study, and scope of study of the research.

Chapter 2: Literature review – This chapter provides important theoretical and conceptual understanding of related topics based on various researches.

Chapter 3: Methodology – The experimental setup of the study will be described. The experimental procedure including design method, and standard referred will be presented in this chapter.

Chapter 4: Result and analysis – Results, analysis, and discussion of experiment are described in this chapter..

Chapter 5: Conclusion – The final chapter will summarize all the results and findings related to this study which achieved the objective, and all the recommendations for further works are presented here.

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