EFFECTS OF AIR VOID AND POROSITY ON MOISTURE DAMAGE OF MALAYSIAN SPECIALTY HMA

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ABSTRACT

One of the main causes of distress in asphalt pavements is damage due to water. This causes related to many effects. The study evaluates different type of asphalt mixtures towards the resistance to moisture damage. The approach is to investigate the relationship between air void and porosity against the abrasion resistance and indirect tensile strength. The evaluation of such properties concentrates on the following three tests; porosity test, indirect tensile test (IDT) and CANTABRO test (CAT) .Three different wearing courses with modified asphalt which porous asphalt (PA),stone mastic asphalt (SMA) and gap-graded asphalt (GPA) that classified by (JKR/SPJ/2007) are studied. These three mixtures were designed by means of Superpave method to determine OBC. After that Specimens were prepared by means of Superpave Gyratory Compactor (SGC) and divided in two different subsets for controlled dry and wet conditioned testing and tested for water damage. Results provide relationship between porosity and air voids for PA mixture. In addition, study also able to establish good models for SMA and GPA mixes compared to other researcher (Walaa,2002). SMA and GPA mixtures (low porosity) showed less influence to moisture damage probably due to the reduce amount of penetrating water. The IDT and CAT are able to discriminate between mixtures of different porosity.

ABSTRAK

Salah satu punca utama masalah yang merisaukan dalam laluan pejalan kaki asphalt ialah kerosakan disebabkan air. Masalah ini berkaitan dengan pelbagai kesan. Kajian ini mengkaji beberapa jenis campuran asphalt ke arah ketahanan dari kerosakan yang disebabkan oleh kelembapan. Kaedahnya adalah dengan mengkaji kaitain antara ruang dan liang udara dengan ketahanan kemelecetan dan kekuatan ketengan secara tidak langsung. Pengkajian tentang perkara-perkara tersebut menumpu kepada tiga ujian berikut; ujian liang udara, ujian ketegangan secara tidak langsung, dan ujian CANTABRO. Tiga laluan berlainan dengan asphalt yang telah diubah kepada porous asphalt (PA), batu mastic asphalt (SMA), dan gap-graded asphalt (GPA) yang telah diklasifikasi oleh (JKR/SPJ/2007) telah dikaji. Ketiga-tiga campuran ini telah direka menggunakan kaedah Superpave untuk menetutkan OBC. Selepas specimen telah disediakan menggunakan Superpave Gyratory Compactor (SGC) dan dibahagikan kepada dua subset yang berbeza untuk ujian kekeringan dan kebasahan terkawal dan diuji untuk kerosakan air. Keputusan menujukan hubungan antara liang dan ruang udara untuk campuran PA. Tambahan itu, kajian juga telah berjaya memberikan model yang baik bagi campuran SMA dan GPA dibandingkan dengan pengkaji yang lain (Walaa,2002). Campuran SMA dan GPA (liang udara yang rendah) telah menunjukkan pengaruh yang kurang kepada kerosakan yang disebabkan oleh kelembapan kerana pengurangan jumlah ketembusan air. IDT dan CAT berupaya membezakan campuran liang udara yang berlainan.

TABLE OF CONTENTS

CHAPTER 1

PROJECT OVERVIEW

1.1 Introduction

Moisture damage of Hot Mix Asphalt (HMA) mixtures, generally called stripping, is a major form of distress in asphalt concrete pavement. Water is a primary cause of stripping of asphalt pavements since it accelerates or causes typical pavement distresses such as bleeding, rutting, cracking, raveling and localized failures (potholes) (Hicks,2003). It is characterized by the loss of adhesive bond between the asphalt binder and the aggregate (a failure of the bonding of the binder to the aggregate) or by a softening of the cohesive bonds within the asphalt binder (a failure within the binder itself), both of which are due to the action of loading under traffic in the presence of moisture.

Water flows through accessible voids or pore spaces in a pavement. Hence, the rate of flow must be related to the amount of water accessible voids, or porosity, in some way. Therefore, the porosity or permeability must be a function of air void. The nature and the growth rate of the traffic effects are associated with static and dynamic processes. Static processes cause weakening of cohesion and adhesion or structural destruction after freeze thaw cycles (Little, 2003). In case of water saturated pavements, the dynamic processes are directly related to traffic action which generates tension and water pressure in pores. This process starts when the water is allowed to circulate freely through the interconnected voids (Kandhal, 2001).

The potential for moisture damage in HMA has traditionally been evaluated through laboratory testing. Factors affecting moisture damage of HMA have been identified as the type and use of the mix, the characteristics of the asphalt binder and the aggregate and environmental effects during and after construction, and the use of anti-stripping additives (Kiggundu,1988), (Stuart,1990) and (Hicks,1991).

Malaysia, like many other countries in the world has relatively high rainfall ranging from 400 to 450 mm monthly. Rainfall is distributed throughout most of the year with portions of the months (June and July) being dryer than other months (monthly weather review 2008). Water penetrated through pores or affected cracks areas of the pavements, and caused stripping. In general, after being open to traffic for approximately four years, the pavements experienced minor to medium cracking problems. The effect of porosity on pavements associated with moisture damage immediate after being open to traffic is an important, yet often overlooked, issue .Three different wearing courses modified asphalt mixtures classified by (JKR/PSJ/2007), (PA) porous asphalt, (SMA) stone mastic asphalt and (GPA) gap graded asphalt were be evaluated in this study for the moisture damage.

1.2 Problem statement

The environment and traffic effects are associated with static and dynamic processes. Static processes cause weakening of adhesion between binder and aggregate or structural destruction after freeze thaw cycles (Little,2003). In case of water-saturated pavements, the dynamic processes are directly related to traffic action, which generates tension and water pressure in pores. This process starts when the water is allowed to circulate freely through the interconnected voids (Kandhal, 2001). Both dynamic and static processes are related to air voids and porosity content. As water passes through pores voids, these effects might result in a weak and saturated pavement immediate after being open to traffic. The action of water in an asphalt mixture is, however, highly complicated. No single theory can well explain the effect of porosity on moisture damage.

1.3 Objectives

To date, there has not been any guideline to determine the potential of water damage in asphalt mixtures associated with porosity. The objectives of this study are as follows:

- Water flows through accessible voids or pore spaces in a pavement. Hence, the rate of flow must be related to the amount of water accessible voids, or porosity, in some way. Therefore, the porosity or permeability must be a function of air void.
- This study is attempted to simulate the water damage on asphalt pavement by indirect tensile strength and compacted mixtures loses.

1.4 Scope of the Study

This study involves laboratory experiments where this study focus on three different wearing courses modified asphalt mixtures classified by (JKR/PSJ/2007), (PA) porous asphalt, (SMA) stone mastic asphalt and (GPA) gap graded asphalt were be designed and evaluated in this study for the moisture damage. The mixtures design followed superpave method and their evaluated for moisture damage conducted by CANTABRO test (CAT) and indirect tensile test (IDT).

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