EFFECT OF FINE AGGREGATE ANGULARITY ON RUTTING RESISTANCE OF ASPHALT CONCRETE AC10

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Specially dedicated to my beloved parents,

Hj Ramli Ismail & Hjh Nor Azian Ahmad

and my family members,

Izzat & Suliza

Thanks for your prays and supports....

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ABSTRACT

Fine Aggregate Angularity (FAA) has been identified as one of the important aggregate properties contributing to the stability of Hot Mix Asphalt (HMA)and its resistance against permanent deformation such as rutting.The performance of dense graded asphalt mixture is significantly influenced by the shape, angularity and surface texture of fine aggregates. This study determines the FAAfor different types of aggregates namely granite and natural sand andevaluates the rutting resistance of AC 10 mixture added with the aforementioned aggregates. Besides the FAA test, other tests that were carried out include Marshall test and wheel tracking test for measuring the rutting resistance. Marshall Procedures were undertaken to obtain the stiffness, stability, density, flow, VTM and VFB. It was found that Marshall properties for mixture added with crushed aggregate are higher than mixture with natural sand in terms of Stability, Stiffness, and Flow. The result shows that mixture with crushed granite has higher percentage of FAA (46%)compared to the one with natural sand (37%).From wheel tracking test, it was observed that the rut depth for specimen with crushed granite is higher compared to specimen with natural sand.Therefore it can be concluded that fine aggregates with more angular shape, increase the rutting resistance.

ABSTRAK

Kesegian Agregat Halus (FAA) dikenal pasti sebagai salah satu daripada sifat penting agregat yang menyumbang kepada kestabilan Asfalt Campuran Panas (HMA) Ia juga memberi kekuatan rintangan terhadap kerosakan ubah bentuk kekal jalan seperti aluran. Prestasi campuran asfalt bergred tumpat ketara dipengaruhi oleh tekstur bentuk, kesegian dan permukaan agregat halus. Objektif kajian ini adalah untuk menentukan nilai FAA bagi jenis agregat yang berbeza iaitu granit yang hancur dan pasir semulajadi, dan penilaian terhadap rintangan aluran campuran AC 10 dengan agregat yang dinyatakan. Selain ujian FAA, ujian lain juga dijalankan termasuklah ujian Marshall dan ujian roda pengesanan untuk mengukur rintangan aluran. Prosedur Marshall telah dijalankan untuk mendapatkan kekukuhan, kestabilan, ketumpatan, aliran, VTM dan VFB. Ujian mendapati ciri-ciri Marshall bagi agregat hancur adalah lebih tinggi daripada pasir semulajadi dari segi Kestabilan, Kekukuhan, dan Aliran Ia juga menunjukkan bahawa granit terhancur mempunyai peratusan FAA yang lebih tinggi (46%) berbanding dengan pasir semulajadi (37%). Daripada ujian pengesanan roda, diperhatikan bahawa kedalaman aluran untuk spesimen yang mempunyai granit hancuradalah lebih rendah berbanding spesimen dengan pasir semulajadi. Oleh itu kesimpulan dapat dibuat bahawa agregat yang mempunyai nilai FAA lebih tinggi boleh meningkat rintangan kepada aluran.

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LIST OF ABREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC10	Asphaltic Concrete Wearing With 10 mm Nominal Maximum Aggregate Size
ASTM	American Society for Testing and Materials
FAA	Fine Aggregate Angularity
HMA	Hot Mix Asphalt
JKR	Jabatan Kerja Raya
MS	Malaysian Standard
TMD	Theoretical Maximum Density
VMA	Voids in Mineral Aggregate
VTM	Void Ratio in Mix
VFB	Void Filled Bitumen
OBC	Optimum Bitumen Content
g	gram
mm	millimetre
Mpa	Megapascal
N	Newton
ºC	Degree celcius
%	Percent

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The main mechanisms of pavement deterioration are rutting and fatigue cracking. Nowadays, rutting has become a major problem due to traffic growth and higher axle loads projected from heavy vehicles. Rutting in asphalt pavements continues to create problems and reduce pavement performance. One factor that has been identified in determining the rutting susceptibility in asphalt pavement is the fine aggregate angularity (FAA) in the asphalt mix.

1.2 Problem Statement

HMA pavements have experienced premature rutting due to increases in the traffic loading. Truck tire pressure, axle load, and volume of traffic have increased considerably in recent years. Inappropriate selections of aggregate and binder quality and quantity for HMA production, contribute to rutting of asphalt pavements. The use of poorly graded aggregates having smooth, sub-rounded particles and a high percentage of rounded sand have contributed to the loss of shearing resistance in asphalt mixtures.

In HMA mixtures, aggregate particles usually comprise of 94 to 96 percent by weight of the total mix with approximately 40 percent is fine aggregate (passing 4.75 mm or No. #4 sieve). The quality and quantity of fine aggregates play a very important role in determining the rutting resistance in asphalt mixtures. Their properties that influence the rutting resistance are particle shape or angularity, particle surface texture and particle porosity (Chowdhury, Button, Kohale, & Jahn, 2001).

1.3 Background Study

Fine aggregate can be considered as a primary constituent in asphalt mixtures. Hence, the properties of fine aggregates such as physical, chemical and mechanical properties play a significant role in determining the characteristics of the bituminous mixtures. The physical properties of aggregates are gradation, particle shape, surface texture, durability, cleanliness, toughness, and absorption. These properties primarily control the performance of mixtures.

Recent studies of Strategic Highway Research Program (SHRP) identified Fine Aggregate Angularity as one of the important aggregate properties contributing to the stability and resistance against permanent deformation of asphalt mixture.

1.4 Aims and Objectives

The aim of this study is to investigate the effect of fine aggregate angularity on the rutting resistance. The relative effect of angularity of fine aggregate is determined by using different type of aggregate shape with different sources which represent a wide range of materials used in pavement industry. This variety of aggregates shape will offer a variety of geometric irregularities. The aggregates used in this study are natural sands and crushed granite to make up AC10 for the evaluation.

The objectives of this study are as follows:

i. To determine the Fine Aggregate Angularity for different types of fine aggregate namely crushed granite and natural river sand.
ii. To evaluate the rutting resistance ofAC10 by using different types of fine aggregate.

1.5 Scope of Study

This study focuses on the rutting problem on asphalt pavement type AC 10 by using different types of Fine Aggregate Angularity .The rutting test was conducted on two different aggregate samples that having different FAA values. The fine aggregate angularity test was done to determine the uncompacted void content of fine aggregate material. The void content gives the information of the effect of fine aggregate on the stability and voids in the mineral aggregate. The results were factors like mineralogical properties of fine aggregate and the crusher type that determining the angularity of fine aggregate. The rutting test also shows that higher FAA values will increase the resistance to rutting problem of asphalt mixture.

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