

**INFLUENCE OF FLAKY AGGREGATE ON MARSHALL PROPERTIES
FOR ASPHALTIC CONCRETE AC 20 MIXTURE**

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*“With the name of Allah and with the help of Allah, all good ascriptions,
devotions, good expressions and prayers only for Allah.”*

As Salam

Specially dedicated to my beloved father and mother,

Hj. Abd. Karim Bin Abd. Majid & Hjh. Zarinah Binti Abd. Rashid

Also specially dedicated to my beloved wife and son,

Noriza Binti Mohd. Khalid & Muhammad Zafran Mifzal Bin Zaini

and my family.

Wassalam.

THANK YOU

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Bismilahirrahmanirrahim

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“MAY ALLAH BLESS YOU ALL”

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ABSTRACT

Aggregate is the most important material that been used widely in the road pavement construction together with asphalt binder. The problem scenario is referring the road problems such as deformation, surface defect, cracks and edge defects. Basically, these study is absolutely focusing on influence of flaky aggregate on Marshall Properties for Asphaltic Concrete AC 20 mixture. In order to evaluate these problem, laboratory tests will be carried out are Aggregate Physical Test, Asphalt Test and Marshall Stability Test. The optimum asphalt content (OAC) needs to be determined before preparing samples to run the test by Marshall Properties to obtain the stiffness, stability, density, flow, VTM and VFB. The (OAC) was determined by using bitumen content of 4.5%, 5.0%, 5.5%, 6.0% and 6.5% for stage 1 which are 45 sample were prepared. For stage 2, verification sample was prepared by using (OAC) obtained. This sample used to verify the (OAC) whether it will meet the specification or not at the same time, nine samples were prepared at this stage, samples were mixed together with (OAC) obtained and aggregate. All samples were conducted to Stability Test again. The result shows, the increasing of flaky aggregates on proportion resulting the decreasing value of stability, stiffness VTM and VMA. The decreasing of flaky aggregates on proportion resulting the increasing value of flow and VFB.

ABSTRAK

Dewasa ini, penggunaan agregat dalam pembinaan dandanan permukaan jalan raya adalah secara meluas. Malahan, penggunaan agregat ini merupakan bahan yang paling mustahak digunakan bersama asphalt sebagai bahan pelekat. Senario ini merujuk pada permasalahan atau kecacatan di jalan raya seperti perubahan bentuk, kerosakan permukaan, rekahan dan kerosakan tepi permukaan jalan raya itu sendiri. Pada dasarnya, kajian ini menumpukan pada kesan terhadap bentuk agregat berkeping terhadap Marshall Properties bagi campuran Asfaltik Konkrit yang bersaiz 20mm. Dalam merealisasikan kajian ini, beberapa ujian telah dilaksanakan dengan baik seperti Ujian Analisis Ayakan, Ujian Indeks Kepingan, Ujian Fizikal Agregat, Ujian Asphalt dan Ujian Marshall itu sendiri. Pada peringkat awalan, agregat berkeping tersebut diagih-agihkan mengikut komposisi kandungan yang ditentukan iaitu 10%, 20% dan 30%. Seterusnya, kandungan Optimum Asphalt diperolehi melalui Marshall Properties iaitu dengan memperolehi terlebih dahulu nilai-nilai bagi stiffness, stability, density, flow, VTM and VFB. Kandungan Optimum Asphalt percubaan yang digunakan dalam kajian ini adalah 4.5%, 5.0%, 5.5%, 6.0% dan 6.5% . Dalam kajian ini, terdapat 2 peringkat, pada peringkat pertama, terdapat 45 sample disediakan. Manakala, pada peringkat 2, 9 sample verifikasi disediakan menerusi campuran bersama kandungan Optimum Asphalt yang diperolehi dari peringkat pertama tadi. Peringkat ini juga, merupakan peringkat semak semula kandungan Optimum Asphalt sama ada ia masih relevan digunakan mengikut spesifikasi yang ditetapkan atau sebaliknya. Kesemua sample tersebut diuji melalui Ujian Stability. Hasil dari ujian tersebut, didapati adanya penurunan pada nilai stability, stiffness, VTM dan VMA sekiranya terdapat peningkatan penggunaan kandungan agregat berkeping Manakala, terdapat peningkatan pada nilai flow dan VFB sekiranya terdapatnya pengurangan penggunaan kandungan agregat berkeping.

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LIST OF ABBREVIATIONS

AASHTO	-	American Association of State Highway and Transportation Officials
AC20	-	Asphaltic Concrete Wearing With 20 mm Nominal Maximum Aggregate Size
ASTM	-	American Society for Testing and Materials
HMA	-	Hot Mix Asphalt
JKR	-	Jabatan Kerja Raya
MS	-	Malaysian Standard
TMD	-	Theoretical Maximum Density
VTM	-	Void Ratio in Mix
VFB	-	Void Filled Bitumen
VMA	-	Void in The Mineral Aggregate
OAC	-	Optimum Asphalt Content
g	-	gram
N	-	Newton
mm	-	milimeter
Mpa	-	Megapascal
N	-	Newton
°C	-	degree celcius
%	-	percent

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CHAPTER 1

INTRODUCTION

1.1 General

Hot mix asphalts (HMA) are used as surface layers in a pavement structure to distribute stresses caused by loading and to protect underlying unbound layers from the effects of water. Therefore, to adequately perform both of these functions over the pavement design life, the mixture must also withstand the effects of air and water, resist permanent deformation, and resist cracking caused by the loading and environment. HMA can produce when asphalt is liquefied by applying heat for mixing with aggregate. Both the asphalt binder and aggregate are heated to get a fluidity to coat the aggregate and to dry the aggregate (Elizabeth Chong, 2007). Various construction of pavement will require different kind of mixture to suit to the desirable strength of pavement. There are many methods of designing a HMA mix, which are Hveem and Marshall Method.

Aggregate is the most important material that common use into the road pavement construction together with asphalt in HMA as well. In general, aggregates can contribute to the major effects of the road problems in future such as surface defect, cracks, and others because these material is constitute approximately 90% of

HMA by weight and made up predominantly of coarse aggregate. In addition, not proper mixing and compaction materials processes also resulting to the road problems. Therefore, to avoid these happen on the real situation, aggregates in HMA are determined by evaluating in term of gradation, cleanliness, toughness, soundness, surface texture, particle shape and others to ensure these material is in good quality condition to use in term of workability and durability.

A part from that, the Research has shown that aggregate characteristics such as particle size, shape, and texture influence the performance and service ability of HMA pavement (Brown et al. 1989; Kandhal et al. 1992; Kim et al. 1992). Flat and elongated particles tend to break during mixing, compaction, and under traffic. Therefore, aggregate shape is one of the important properties that must be considered in the mix design of asphalt pavements to avoid premature pavement failure. It is now widely accepted that the manufacturing of raw material in aggregate production offers an environmentally responsible and economically viable option to convert this material into a valuable resource. The asphalt industry believes raw material such as flat and elongated particles are undesirable. Several design procedures have specifications limiting the percentage of flat and elongated allowed in the mix.

1.2 Problem Statement

The physical properties of aggregates is referring to the physical structure of the particles that make up the aggregate as the finished product. In addition, aggregates is the major ingredients in hot mix asphalt which can influenced HMA performance. Normally, in all cases the aggregates used should meet five requirements as follow:

- i. Strong, tough and durable
- ii. The ability to be crushed into bulky particles, without many flakiness particles, slivers or pieces that are thin and elongated.
- iii. Low porosity
- iv. Low permeability
- v. Correct particle size and gradation

Research has shown that aggregate characteristics such as particle size, shape, and texture influence the performance and service ability of HMA pavement (Brown et al. 1989; Kandhal et al. 1992; Kim et al. 1992). In addition, Flaky and elongated particles tend to break during mixing, compaction, and under traffic. Therefore, these study is absolutely focusing on the effects of flaky aggregates with Marshall Stability.

1.3 Objective of Research

The objectives of this study can be listed as follow;

- (i) To determine OAC for AC 20 based on the proportion of flaky aggregates.
- (ii) To develop relationship between different of flaky aggregate proportion with Stability.

1.4 Scope of Study

The scope of study is listed as follow;

- i. To focus on the flaky aggregate proportion use where; 10%,20% and 30% on Marshall Mix Design Method with PEN 80/100 for binder use.
- ii. This research was involving laboratory test methods which are Aggregate Physical Test, Asphalt Test and Marshall Stability Test.
- iii. This research involves on studying only the surfacing of pavement considering while the bottom layer have the strength comply with the specification.

1.5 Significance of Research

This study was develop understanding on how the influence of flaky aggregates on asphalt mix in Malaysia. High percentage of flaky aggregate in asphalt mix will not only reduce the shear strength of the pavement but it also reduces the performance of the pavement. The significance of this research is listed as follow;

- i. To understand the significant influence of flaky shape of the aggregate in asphalt mix especially in Malaysia environment.
- ii. To assist in identify the understanding on the characteristic and physical properties of aggregates and asphalt.

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