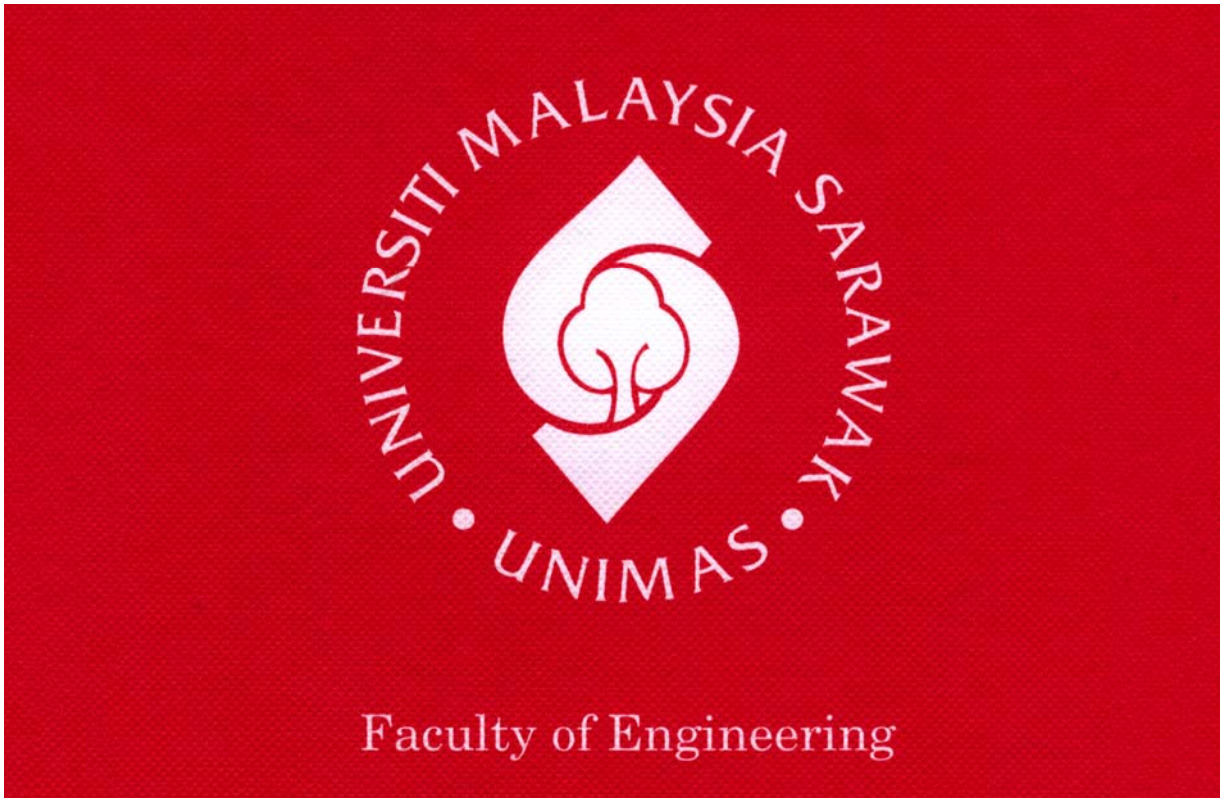

THE EVALUATION OF MARSHALL PROPERTIES OF CARBIDE LIME AS A FILLER MATERIAL IN ACW 20 HOT MIX ASPHALT (HMA)

LEE YUNN ZYE

Bachelor of Engineering with Honors
(Civil Engineering)
2009

UNIVERSITI MALAYSIA SARAWAK

BORANG PENGESAHAN STATUS TESIS

JUDUL: **THE EVALUATION OF MARSHALL PROPERTIES OF CARBIDE LIME AS A FILLER MATERIAL IN ACW 20 HOT MIX ASPHALT (HMA)**

SESI PENGAJIAN :2008/2009

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THE EVALUATION OF MARSHALL PROPERTIES OF CARBIDE LIME AS A FILLER MATERIAL IN ACW 20 HOT MIX ASPHALT (HMA)

LEE YUNN ZYE

This project is submitted in partial fulfilment of the requirements for the degree of
Bachelor of Engineering with Honours
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2009

"Dedicated to my beloved family..."

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TABLE OF CONTENTS

CHAPTER 2: LITERATURE REVIEW

CHAPTER 3: METHODOLOGY

CHAPTER 4 : RESULTS, ANALYSIS AND DISCUSSIONS

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

LIST OF FIGURES

LIST OF SUBSCRIPTS

HMA	Hot Mix Asphalt
VMA	Voids in Mineral Aggregates
VTM	Voids in Total Mix
VFA	Voids Filled with Asphalt Cement
ASTM	The American Society for Testing and Materials
OAC	Optimum Asphalt Content
SSD	Saturated Surface Dry
JKR	Jabatan Kerja Raya
UNIMAS	Universiti Malaysia Sarawak

LIST OF SYMBOLS

%	percentage
ºC	Celsius
µ	Micron
mm	Millimeter
m	Meter
G_{Sa}	Apparent specific gravity
G_{Sb}	Bulk specific gravity
G_{Sc}	Effective specific gravity
V_B	Volume of constituent binder
M	Mass of specimen
V	Bulk volume of specimen
M_{BA}, V_{BA}	Mass and volume of absorbed binder
M_B	Mass of constituent binder
V_B	Volume of constituent binder
V_{MM}	Volume of void-less mix
V_A	Volume of air between coated aggregate particles in the mix
M_G	Mass of aggregate
V_G	Bulk volume of aggregate
V_{GE}	Effective volume of aggregate
W_a	Weight of specimen in air (kg)

W_w	Weight of specimen in water (kg)
ρ_w	Density of water (= 1000 kg/m3)
W_{pa}	Weight of specimen and paraffin wax coating in air (kg)
W_{pw}	Weight of specimen and paraffin wax coating in water (kg)
G_p	Relative density of paraffin wax
P_{AG}	Binder absorption, % of mass of aggregate
P_B	Binder content, % of total mass of specimen
ρ_B	Density of binder
ρ_G	Bulk density of aggregate
m^3	Meter cubic
mm	mili meter
kN	kilo newton
kg	kilogram
g	Gram

LIST OF TABLES

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ABSTRACT

Marshall Mix design was the conventional method to design the hot mix asphalt (HMA).This paper describes the Marshall Mix design ACW20 using two difference material. One using ordinate aggregate available at UNIMAS civil lab and another one the filler size of 150 μm was replace by carbide lime. The asphalt cement use varies from 4.5% to 6.5% and having penetration grades of 80/100. The mix were compare in term of Marshall Properties such as stability and flow; and volumetric properties are mixture density, Voids Filled with Asphalt (VFA), Voids in Mineral Aggregate (VMA), and Voids in Total Mix (VTM). Study show that the hot mix asphalt for the normal aggregate mix having a greater density but carbide mix having greater stability. The optimum binder content for the normal mix asphalt was 5.13% and 5.63% for the carbide mix. The ACW 20 for the normal mix aggregate does not satisfied JKR requirement for flow and void in total mix mean while the ACW 20 for carbide only fail to satisfy the void in total mix. Carbide mix showing higher stability value hence it has the potential martial for replacing ordinate fine aggregates.

ABSTRAK

Reka bentuk campuran Marshall adalah cara paling konvensional untuk mereka bentuk asfal campuran panas (HMA). Kaji selidik menggambarkan campuran Marshall ACW 20 menggunakan dua bahan yang berbeza. Satu menggunakan agregat biasa yang tersedia di makmal sivil UNIMAS. Satu lagi agregat berukuran 150μm digantikan dengan *carbide lime*. Kandungan asfal berbeza dari 4.5% ke 6.5% dengan gred penembusan 80/100. Kedua- dua campuran ini dibandingkan dari segi Marshall properties seperti kestabilan, aliran: dan ciri-ciri volumetri seperti lompang dalam campuran (VTM), lompang dalam agregat (VMA), lompang terisi simen asfal (VFA) dan kekukuhan. Keputusan kajian menunjukan campuran menggunakan agregat biasa mempunyi ketumpatan yang lebih besar tetapi campuran menggunakan *carbide lime* akan mempunyai kestabilan yang lebih tinggi. Kandungan asfal optimum untuk campuran biasa adalah 5.13% manakala 5.63% untuk campuran *carbide lime*. ACW20 campuran agregat biasa gagal menepati piawaian JKR dari segi aliran dan lompang dalam campuran (VTM) manakala campuran *carbide lime* gagal nenepati lompang dalam campuran(VTM) sahaja. Campuran *carbide lime* menunjukkan kestabilan yang lebih tinggi oleh itu *carbide lime* adalah bahan yang berpotensi untuk menggantikan agregat biasa dalam asfal sampuran panas.

CHAPTER 1

INTRODUCTION AND OBJECTIVES

1.1 General

Hot mix asphalt (HMA) is the widely used primarily as paving material for road construction and consists of a mixture of aggregate and liquid asphalt cement, which are heated and mixed in measured quantities.

During World War II, the U.S. Army Corps of Engineers (USCOE) began evaluating various HMA mix design methods for use in airfield pavement design. Motivation for this search came from the ever-increasing wheel loads and tire pressures produced by larger military aircraft.

The most promising method eventually proved to be the Marshall Stability Method developed by Bruce G. Marshall at the Mississippi Highway Department in 1939. Wes took the original Marshall Stability Test and added a deformation measurement (using a flow meter) that was reasoned to assist in detecting excessively high asphalt contents. (White, 1985)

Marshall Mix Design was widely use because it had several advantage: It was designed to stress the entire sample rather than just a portion of it. It facilitated rapid testing with minimal effort. It was compact, light and portable. It produced densities reasonably close to field densities. It also cheap to be carries out.

The aggregates size smaller than 150 μm are call filler. Filler was a very importance element in term of producing high quality of hot mix asphalt. The filler act as the fill up material between the aggregate void and give the maximum contact surface to all the binder aggregate and avoid segregation of aggregate. Suitable amount of filler added in the hot mix asphalt will produce a dense-grade and strong material.

The filler use in the hot mix asphalt must be not rotten in nature and must able to withstand the heavy load of the traffic flow hence normally nature material like limestone dust or river sand will be chosen as a filler material. In this study the filler will be replace by the carbide lime dust.

Carbide was chosen because is a hard metal and stable in term of physically and chemistry. Carbide lime mostly exist in gray color since it was a hard metal hence it able to sustain a very high temperature.

1.2 Problem statement

Carbide lime was the waste product when processing the liquid oxygen. Sarawak is the state rich of neutral petroleum gas hence million gallon of petroleum gas need to be process into use able liquid oxygen hence there will create a lot of unused able by product of carbide lime. Since carbide lime was belong to metal hydroxide family hence it need to be treated before it can be damp safely. In term of sustainable development it is encourage turning the waste into useable material and in this scope of study the carbide was tested its potential for replacing the fine aggregate in the pavement design.

Then normally use fine aggregate were obtain by harvesting limestone or river sand they need to blast down the mountain or dig the big hole near the river just to obtain the sand. When all this activities were done in big scale it will create a big impact to the nearby ecosystem. In term of sustainable development this should be avoid or reduce.

1.3 Objectives

There were several objectives for this study:

a) Determine the Marshall properties of hot mix asphalt ACW 20 by using carbide as a replacing material for filler element.

b) Compare the Marshall properties of the carbide HMA ACW20 with the normal HMA ACW 20

c) Determine the optimum binder content for both normal ACW 20 and carbide ACW 20

1.4 Scope of study

In this study the aggregate prepared will be according to the ACW 20 wearing course but the filler will be replacing by carbide.

The mix and test will be carrying out according the marshal mix design and Marshall Stability and Flows test. Total number of 15 samples of original filler and 15 sample of carbide as the replacing material will be prepare and tested all the design and test were refer to the AASHTO manual. The physical properties of both different materials will be compare in term of density vs. asphalt content, stability vs. asphalt content, flow vs. asphalt content air void vs. asphalt content, void in the mineral aggregate (VMA) vs. asphalt content and void filled with asphalt (VFA) vs. asphalt content.

All the testing was conducted at Civil Engineering Laboratory, University Malaysia Sarawak.