

EVALUATION OF COMPACTIVE EFFORT AND TIME AVAILABLE FOR
COMPACTION ON HOT MIX ASPHALT

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This thesis is dedicated to My beloved parents Md Noor Bin Mohd Isa
and Norazah Binti Mohd Tahir

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ABSTRACT

The objective of this study was to determine the effect of compaction effort on marshall properties of two types of mix design which is from asphaltic concrete (AC) and bituminous Macadam (BM). The types of mix design are AC14 and BMW20 which is for Hot Mix Asphalt (HMA). This study also determined the time available for compaction for AC14 and BMW20. Compaction is one of the important factor in constructing a pavement. According to JKR specification, the number of blow is 75 per face. For this study, the number of blow used were 35, 50 and 75. Bitumen content that has to be used for asphaltic concrete is between 4 to 6 percent. Compaction, flow and stability test for AC14 were carried out to determine the optimum bitumen content for each blow. The result of OBC for 35 blow was 5.54%, 5.32% for 50 blow and 5.23% for 75 blow. The results show that the increase of the number of blow would decrease the optimum bitumen content. After comparing the parameter, the result for AC14 show that 35 blow and 50 blow of compaction do not meet the specification except for 75 blow. For BMW20, the bitumen content used was 4.9% for each blow. The results for BMW20 show that for each blow which is 35 blow, 50 blow and 75 blow comply to the specification. On the other hand, the time available for compaction of AC14 is 108 minutes and the time available for compaction of BMW20 is 100 minutes.

ABSTRAK

Objektif kajian ini adalah untuk menentukan kesan usaha pemadatan ke atas ciri-ciri Marshall terhadap dua jenis campuran iaitu Konkrit Asphalt dan 'Bituminous Mcadam'. Jenis-jenis campuran yang digunakan adalah AC14 dan BMW20. Kajian ini juga menentukan masa yang diperlukan untuk pemadatan bagi AC14 dan BMW20. Pemadatan adalah salah satu faktor yang penting dalam pembinaan turapan. Mengikut spesifikasi JKR, jumlah pukulan adalah 75 setiap muka. Untuk kajian ini, jumlah pukulan yang digunakan ialah 35, 50 dan 75. Kandungan bitumen yang perlu digunakan untuk konkrit asphalt adalah antara 4 hingga 6 peratus. Pemadatan, ujian aliran dan kestabilan untuk AC14 telah dijalankan untuk menentukan kandungan bitumen optimum bagi setiap pukulan. Hasil OBC untuk 35 pukulan adalah 5.54%, 5.32% untuk 50 pukulan dan 5.23% untuk 75 pukulan. Keputusan menunjukkan bahawa peningkatan bilangan pukulan akan mengurangkan kandungan bitumen optimum. Selepas membandingkan parameter, keputusan untuk AC14 menunjukkan bahawa 35 pukulan dan 50 pukulan pemadatan tidak memenuhi spesifikasi kecuali untuk 75 pukulan. Untuk BMW20, kandungan bitumen yang digunakan adalah 4.9% bagi setiap pukulan. Keputusan bagi BMW20 menunjukkan bahawa setiap pukulan iaitu 35 pukulan, 50 dan 75 telah memenuhi spesifikasi. Selain daripada itu, masa yang ada untuk pemadatan AC14 ialah 108 minit dan masa yang ada untuk pemadatan BMW20 ialah 100 minit.

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LIST OF ABBREVIATIONS/SYMBOLS

HMA	-	Hot Mix Asphalt
ASTM	-	American Society for testing and material
AASHTO	-	American association of state highway and transportation
AC14	-	Asphaltic Concrete with nominal maximum aggregate size of 10 mm
BMW20	-	Bituminous Macadam wearing with nominal maximum aggregate size of 20 mm
OBC	-	Optimum bitumen content
VMA	-	Void in mineral aggregate
VFB	-	Void filled with asphalt binder
VTM	-	Void in total mix
JKR	-	Jabatan Kerja Raya
TMD	-	Theoretical Maximum Density

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CHAPTER 1

INTRODUCTION

1.1 Background

A flexible pavement is a structure that consist of several layer of material that been placed on a subgrade. The lower layer which is the subgrade is the most vital layer in construct the flexible pavement. Typical layer of a conventional flexible pavement includes seal coat, surface course, tack coat, binder course, prime coat, base course, sub base course, compacted subgrade, and natural subgrade as shown in Figure 1 below. It is important to make the subgrade well compacted because well compacted subgrade will give a strength, low in permeability and compressibility so the air void in the subgrade will be less. Subgrade strength is a key component to asphalt pavement design.

Surface Course (25-50 mm)
Binder Course (50-100 mm)
Base Course (100-300 mm)
Subbase Course (100-300 mm)
Compacted Subgrade (150-300 mm)

Figure 1.1 :Typical layer of flexible pavement

Compacted pavement is very important in asphalt pavement design. Compaction will increase the density of the material by expelling air from the voids in the material and will bring the particles into more intimate contact with each other. Compaction also is the cheapest and simplest method for improving the shearing resistance of soil and minimizing future settlements. There are many compacting equipment that can be used to compact the pavement. Good compaction works in pavement can reduce future maintenance and will add the design life of the road. When the density of the pavement is increase, it will gives a greater strength for supporting heavier loads and also give resistance to rutting.

Hot mix asphalt is the most common type of material that been used in paving application around the world. In Malaysia, 95% of the road used hot mix asphalt as the material in construction. Hot mix asphalt is consist of asphalt binder and different size of mineral aggregates. Hot mix asphalt mixture can be divided into three which is dense graded, open gap graded and gap graded aggregate. The behaviour of HMA is depend on each component properties

In this project, laboratory test on the Hot Mix Asphalt (HMA) design regarding marshall properties was carried out . This test been done to determine the optimum bitumen content and also the marshall properties.

1.2 Problem Statement

The Malaysia road network has expanded rapidly in line with the economic growth in Malaysia. The department that responsible for road work is Jabatan Kerja Raya where many project have been done with specification that JKR have produce.

Infra desa is one of the company in Johor Bahru that have been assess the rural road pavement. The road pavement in this country is constructed based on JKR Standard for Road Work, JKR/SPJ/1988. However the problem that Infra desa have is that the pavement does not follow the specification of JKR which is the pavement does not achieved 98% degree of compaction. When the pavement does not achieve 98% degree of compaction, it will make the strength of the pavement been reduce. The void in the pavement also will be increase.

So, the test for the pavement have to be made to know the number of blow that suitable to achieve 98 percent. The compaction test been done starting with 35, 50 and 75 blow according to the bitumen content that have to be added. The range of the bitumen content for AC14 is between 4.0 percent to 6.0 percent.

In accordance with AASHTO Test Method T245, 75 blow of compaction are used to achieved higher density of an asphalt concrete. Density is one of the important component in pavement construction. The purpose to do the compaction efficiently is to reduce the air void space of the pavement. Even though Jabatan Kerja Raya are using 75 blow of compaction in design mix, the higher the compaction the lesser optimum bitumen content is required.

1.3 Objective Of the Study

The objective of study are:

- i. To determine the marshall properties of AC14 and BMW20 of Hot Mix Asphalt (HMA)
- ii. To determine time available for compaction of AC14 and BMW20 of Hor Mix Asphalt (HMA)

1.4 Scope Of the study

The type of mix design that been used in this study is AC 14 and BMW 20 which is Asphaltic Concrete 14 and Bituminous Macadam Wearing 20. The test for both of the mix have to be done to determine optimum bitumen content, marshall properties and also the rate of cooling. The entire test were conducted at Highway and Transportation laboratory of Universiti Teknologi Malaysia.

1.5 Significance of the study

The study area of marshall properties in pavement of HMA is important because it can determine the effective number of blow that suitable to be used to achieve 98% of compaction. This study also will determine the rate of cooling for each type of mix which is AC14 and BMW20. From the result of this study, it can provide better view about marshall properties and the cooling rate of AC14 and BMW20.

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