

EVALUATION OF CRACK RELIEF LAYER FOR ROADS AND HIGHWAYS

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“Dedicated to my family especially my beloved mother Nor Afizan Binti Muhammad Yusof, my beloved father Mustafa Bin Taib , my brother Zafri, my sister Along , brother in law Abang Napi, my little nephews Muiz and Waqiy and also my soon to be wife Nor Syuhada for their love, encouragement and support.”

“Special thanks to all lecturers, friends for their motivation, concern and help.”

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Hopefully, this study will be blessed by Allah and will benefit for future.

ABSTRACT

Roads and highways are the most important mode of transportation systems for development of a nation. In order to fulfill this purpose, the pavement must be able to provide a safe and comfortable riding surface to the road users. However, pavement deterioration is a major obstacle that can prevent a pavement from serving its main purposes. Crack relief layer (CRL) is a layer that is placed in between the new overlay and the old pavement in order to dissipate pavement movements before it creates stress in a new overlay surface. From previous implementation of CRL in airport and runways, the performance is promising to be used in roads and highways in order to overcome pavement distress. This study is done in order to understand the properties of CRL layer as there is limited research carried out previously. It is expected that this study could help develop or improve design standards and/or material or construction specifications to minimize the cracks development on pavement. In this study, bitumen penetration grade 80-100 was used at 2, 2.5, 3, 3.5 and 4% in order to determine the most suitable percentage of bitumen that should be used for CRL sample. The sample was tested by using Marshall Test in order to determine its parameter such as density, stability, flow, void content in total mix (VTM), and void filled with bitumen (VFB). The results indicated that 3% of bitumen as the most suitable percentage of bitumen that should be used for CRL. CRL layer also had higher resilient modulus compare to other pavement type which shows that it able to absorb the stress been exerted on it more efficiently and prevent the crack from top and bottom of the road from spreading to the surface and also the subgrade. This shows that CRL had the potential to be the solution for road distress that occurs on the pavement.

ABSTRAK

Jalan raya merupakan sistem pengangkutan yang paling penting dalam pembangunan sesebuah Negara. Oleh itu, turapan jalan hendaklah berupaya menyediakan permukaan yang selamat dan selesa kepada pengguna jalan raya. Walau bagaimanapun, kemerosotan turapan adalah halangan utama yang boleh menghalang turapan jalan daripada menjalankan tugasnya. 'Crack Relief Layer' (CRL) merupakan lapisan yang diletakkan diantara lapisan baru dan turapan lama untuk menghalang pergerakan turapan sebelum tekanan terhasil pada lapisan baru. Pelaksanaan lapisan CRL di lapangan terbang menunjukkan lapisan ini mempunyai potensi untuk digunakan di jalan raya dan lebuh raya untuk menangani keretakan pada turapan jalan. Kajian ini dijalankan bagi memahami sifat-sifat lapisan CRL kerana kurangnya kajian yang dijalankan bagi memahami lapisan ini. Kajian ini diharapkan dapat membantu membangunkan dan menambahbaik piawaian rekabentuk dan bahan atau spesifikasi pembinaan bagi mengurangkan keretakan pada turapan. Dalam kajian ini, bitumen penusukan gred 80-100 telah digunakan pada 2, 2.5, 3, 3.5 dan 4% untuk menentukan peratus bitumen paling sesuai yang perlu digunakan untuk sampel CRL. Sampel telah diuji dengan menggunakan ujian Marshall untuk menentukan parameternya seperti ketumpatan, kestabilan, aliran, kandungan lopong dalam jumlah campuran (VTM), lopong dipenuhi dengan bitumen (VFB) dan 'Resilient Modulus'. Keputusan menunjukkan bahawa 3% daripada bitumen sebagai peratusan yang paling sesuai bitumen yang perlu digunakan untuk CRL. Lapisan CRL juga mempunyai nilai 'Resilient Modulus' yang tinggi berbanding dengan jenis turapan lain yang menunjukkan bahawa ia mampu menyerap tekanan yang telah dikenakan ke atas ia lebih cekap dan mengelakkan retak dari atas dan bawah jalan dari merebak ke permukaan dan juga subged. Ini menunjukkan bahawa CRL mempunyai potensi untuk menjadi penyelesaian untuk masalah keretakan yang berlaku di turapan jalan.

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LIST OF ABBREVIATIONS/SYMBOLS

AASHTO	-	American Association of State Highway and Transportation
AIV	-	Aggregate Impact Value
CRCP	-	Continuously Reinforced Concrete Pavement
CRL	-	Crack Relief Layer
CTB	-	Cement Treated Base
cP	-	Centipoise
dmm	-	Desimillimeter
JKR	-	Jabatan Kerja Raya
KLIA	-	Kuala Lumpur International Airport
LAAB	-	Los Angeles Abrasion Value
OBC	-	Optimum Bitumen Content
Pvt.	-	Private
Mr	-	Resilient Modulus
SN	-	Sample Number
TMD	-	Theoretical Maximum Density
VFB	-	Voids Fill with Bitumen
VIM	-	Voids in Mineral Aggregate
VTM	-	Voids in Total Mix
	-	

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CHAPTER 1

INTRODUCTION

1.1 Background

Road infrastructure is crucial in improving the economy of a country and is one of the factors for increasing development of an area. Increasing socio-economic development is an important factor in the high demand of highway construction, new roads and upgrading existing roads to meet the needs of road users and increase traffic at present (Kim 2006). Construction of roads and highways consume large amount of money in order to ensure road worthiness, safety and end user satisfaction (Donnges, Edmonds et al. 2007). However, pavement deterioration is a common phenomenon that occurred once it is opened for trafficking (Bank 2013).

As it is widely known that pavement crack is a major problems that can reduce the workability of pavement layers. As today, there are many type of crack mitigation technique that been introduce. In airport runways, they had use Crack Relief Layer (CRL) as a method to minimize the crack propagation on the pavement. This layer had been used in many airports construction around the world. As people knows the airport runways must have a very good properties of pavement in order to withstand the incredible amount of load that been imposed on the pavement. Although , it had

been use in many airport runways project, the implementation of CRL layer is not widely published. So there is very little information about this layer had been known by people in the transportation industry.

1.2 Problem Statement

Road damage normally occur as there is disturbance to the pavement strata due to crack development. Crack development in pavement could lead to water infiltrate pavement layer that will damaging the bond within the layer and also reducing it load bearing capacity. It also will damaging California Bearing Ratio (CBR) of subgrade and other layer.

Crack relief layer claimed to works as a cushion layer that can absorb the cracks propagation on pavement layers. Therefore, the aims of this study is to understand the properties of Crack Relief Layer in order for it to be used as additional layer for minimizing the cracks development in current pavement layers.

1.3 Objectives of the Study

The objectives of this study are:

- i. To determine the Optimum Bitumen Content (OBC) for Crack Relief Layer.
- ii. To evaluate the engineering properties of Crack Relief Layer.

The engineering properties of CRL that will be evaluated are the air voids content, bulk density values, stability and resilient modulus. In addition, the results from this study are expected to give guidance on CRL.

1.4 Scope of Study

This study involves few objective that need to be accomplish and need a meticulous implementation of work. The scope of the study focuses on design mix of CRL with the used of bitumen penetration grade 80-100 at 2, 2.5, 3, 3.5 and 4%. A total five mix design on 15 samples of CRL were prepared at level of compaction of 50 blows/face. The sample was tested by using Air Void and Density Test, Marshall Flow and Stability Test and Resilient Modulus Test.

1.5 Significance of Study

Despite the significant advances in the understanding of cracking phenomenon, there is still minimal practical technical guidance for a roads and highways pavement designer or contractor on treating it. There also no significant effective method for treatment of cracking in pavement.

The understanding about CRL layer is very low as the specification of this layer was kept secret within people in airport runway industry. It is hoped that this study will help people in the transportation industry to understand more about this layer and also will be used as guidance for further study of this layer.

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