

**INVESTIGATIONS OF FACTORS AFFECTING PENDULUM TEST VALUE
ON ASPHALTIC CONCRETE SURFACES**

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*Dedicated To Highway Engineering
Relevant Parties...*

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ABSTRACT

Skidding is one of the major contributions to road accidents during wet weather condition. Therefore, a study is conducted to investigate the factors affecting Pendulum Test Value on Asphaltic Concrete surfaces. The main objective of this study is to determine the mix type and the crossfall percentage that best resist skid during wet weather condition. Three different types of dense graded mixes were used in this study which are AC10, AC14 and AC20. Those three mixes are tested using Sand Patch Test (SPT) and are then subjected to various rainfall conditions and crossfall percentages using Rainfall Simulator. The rainfall conditions are categorized as low rainfall, medium rainfall and high rainfall while the crossfalls were increased 2% from 0% to 10% crossfalls. During the event of rainfall on each mix surfaces, a Portable Skid Resistance Tester is used on the mix to obtain the Pendulum Test Value (PTV) at different crossfalls. Results are analyzed using analysis of variance (ANOVA) to justify the objectives. Results from PTV shows that 4% to 10% crossfall and AC20 is the best crossfall and surface type in resisting skid.

ABSTRAK

Gelinciran merupakan salah satu penyumbang utama kepada kemalangan jalan raya terutamanya ketika hujan. Oleh itu, kajian ini dijalankan untuk menyelidik faktor-faktor yang mempengaruhi rintangan gelinciran di atas permukaan konkrit berasfal. Objektif utama kajian ini ialah untuk menentukan jenis campuran dan peratus sendengan jalan yang terbaik untuk menghalang dari berlakunya gelinciran ketika keadaan hujan. Tiga jenis campuran konkrit berasfal digunakan dalam kajian ini iaitu AC10, AC14 dan AC20. Ketiga-tiga campuran tersebut diuji menggunakan ujian tampalan pasir dan kemudiannya dikenakan keadaan hujan dan peratus sendengan jalan yang berlainan dengan menggunakan alat simulasi hujan. Keadaan hujan yang dikenakan adalah hujan renyai, hujan sederhana dan hujan lebat manakala sendengan jalan ialah dari 0% hingga 10% dengan kenaikan 2%. Ketika hujan dikenakan ke atas permukaan campuran konkrit berasfal. Alat rintangan gelinciran diletakkan di atas campuran konkrit berasfal untuk mendapatkan bacaan rintangan gelinciran pada sendengan jalan berlainan. Keputusan akan dianalisa menggunakan Analysis of Variance (ANOVA) untuk mengesahkan objektif tersebut. Keputusan nilai rintangan gelinciran menunjukkan bahawa sendengan jalan 4% hingga 10% dan AC20 ialah sendengan jalan dan jenis permukaan yang terbaik untuk menghalang gelinciran.

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LIST OF SYMBOLS AND ABBREVIATIONS

AC	Asphaltic Concrete
NAPA	National Asphalt Pavement Association
JKR	Jabatan Kerja Raya
ATJ	Arahan Teknik Jalan
ASTM	American Society for Testing and Materials
AASHTO	American Association of State Highway and Transportation Officials
UTM	Universiti Teknologi Malaysia
OBC	Optimum Bitumen Content
MRP	Malaysia Rock Product
SPT	Sand Patch Test
BPT	British Pendulum Tester
BPN	British Pendulum Number
PTV	Pendulum Test Value
SRV	Skid Resistance Value
WFT	Water Film Thickness
ANOVA	Analysis of Variance

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CHAPTER I

INTRODUCTION

1.2 General

Skidding is one of the most common contributors to accidents. Skidding is more effective to happen during wet pavement condition. Apart from that, skidding also can happen due to the insufficient of pavement crossfall and pavement surface characteristics. Skidding can be avoided if there is a good friction between tyre and pavement.

Pavement surface characteristics are important for both the safety and comfort of drivers. Pavement surfaces should provide adequate friction and maintain a good level of ride quality and to ensure the satisfaction of the driving. Both the macrotexture and microtexture plays an important role in the friction characteristics of pavement surfaces.

The frequency of rainfall based on rainfall intensity also contributes in pavement friction. The frequency of rainfall develops water film on pavement which exists between the tyre-pavement contact. This could eventually creates hydroplaning thus contributes to skidding.

Crossfall is another important element in providing good friction between tyre and pavement. Crossfall is essential in highway construction since it functions to reduce water on pavement during rainy weather.

1.2 Problem Statement

Malaysia is currently having one of the best road systems in Asia. Eventhough Malaysia has the best road system; the accident rate is Malaysia increased at an average rate 9.7% yearly (Royal Malaysian Police, 2005). Figure 1.1 below shows that road accidents had increased from 24,581 cases in 1974 to 328,264 cases in 2005.

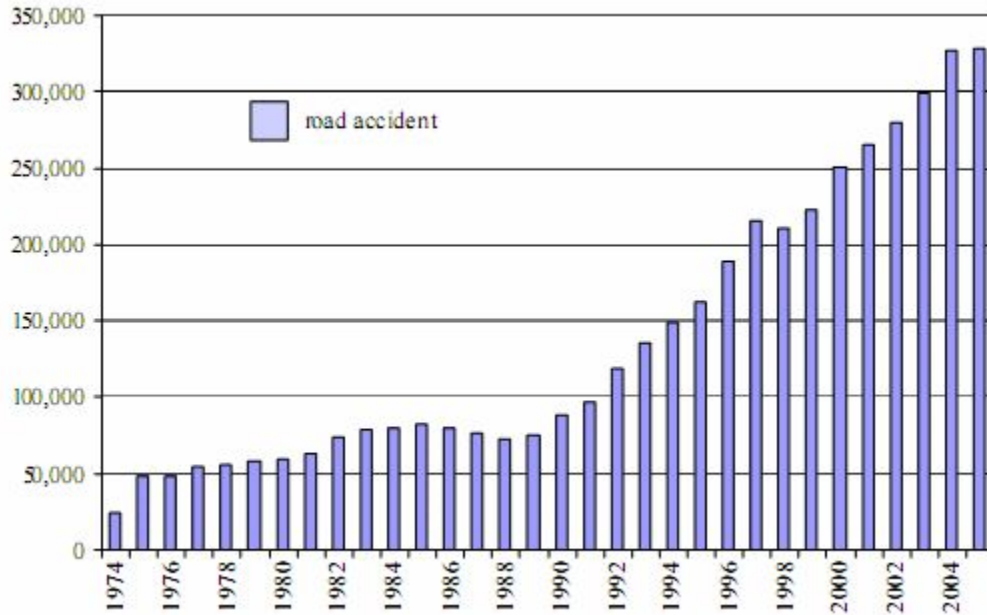


Figure 1.1: Statistics Road Accidents in Malaysia Year 1974 to Year 2005
(Royal Malaysian Police, 2005).

Accidents is high in Malaysia due to many factors such as the driver carelessness, vehicle speed, braking distance, insufficient head distance and skidding especially on wet condition.

One major factor contributes to road accident is skidding as there is connection between vehicle tyre and pavement. The worst skidding ever happen is during wet pavement condition during rainy day. Besides that, a research shows that skidding contributes to 25% of wet road accidents in United Kingdom (Kennedy *et al.*, 1990).

As Malaysia utilizes more Asphaltic Concrete pavements and Malaysia is located in Khatulistiwa climate region, the skidding rate on wet pavement condition has to be determined. Therefore a lab test will be carried out to investigate the factors affecting the Pendulum Test Value of Asphaltic Concrete surfaces.

1.3 Objective of Study

The objectives of this study are:

- to investigate the effect Pendulum Test Value on various rainfall intensities, various crossfalls and on different Asphaltic Concrete surfaces during rainfall.
- to recommend the crossfall and pavement type that best resist skid during wet pavement condition.

1.4 Scope of Study

This study is carried out at Makmal Jalanraya, Universiti Teknologi Malaysia (UTM). Rainfall Simulator is used to simulate various type of rainfall on pavement. Three asphaltic concrete pavement type being used in this study which are AC10, AC14 and AC20. Crushed aggregates from a quarry in Ulu Choh and bitumen of 80/100 Pen is used for the design mix. Sand Patch Test is carried out on every mix samples. Besides that, the Pendulum Test Value is determined by using Portable Skid Tester. Data from Manual Saliran Mesra Alam (MASMA, 2000) is used to calculate rainfall intensities and Jabatan Kerja Raya (JKR, 2005) specification is used in the mix design for this study.

1.5 Importance of study

The importance of this study is mainly to propose the best crossfall and the best asphaltic concrete mix type to resist skid by rainfall simulation before constructing road on a particular area. Other than that, by conducting this study, the relationship of crossfall, rainfall intensity and pavement texture can be observed and determined. Besides that, this study can be highlighted as a proposal to JKR and local authorities. Overall, this study is aimed to give a new idea and concept towards the road development in Malaysia.