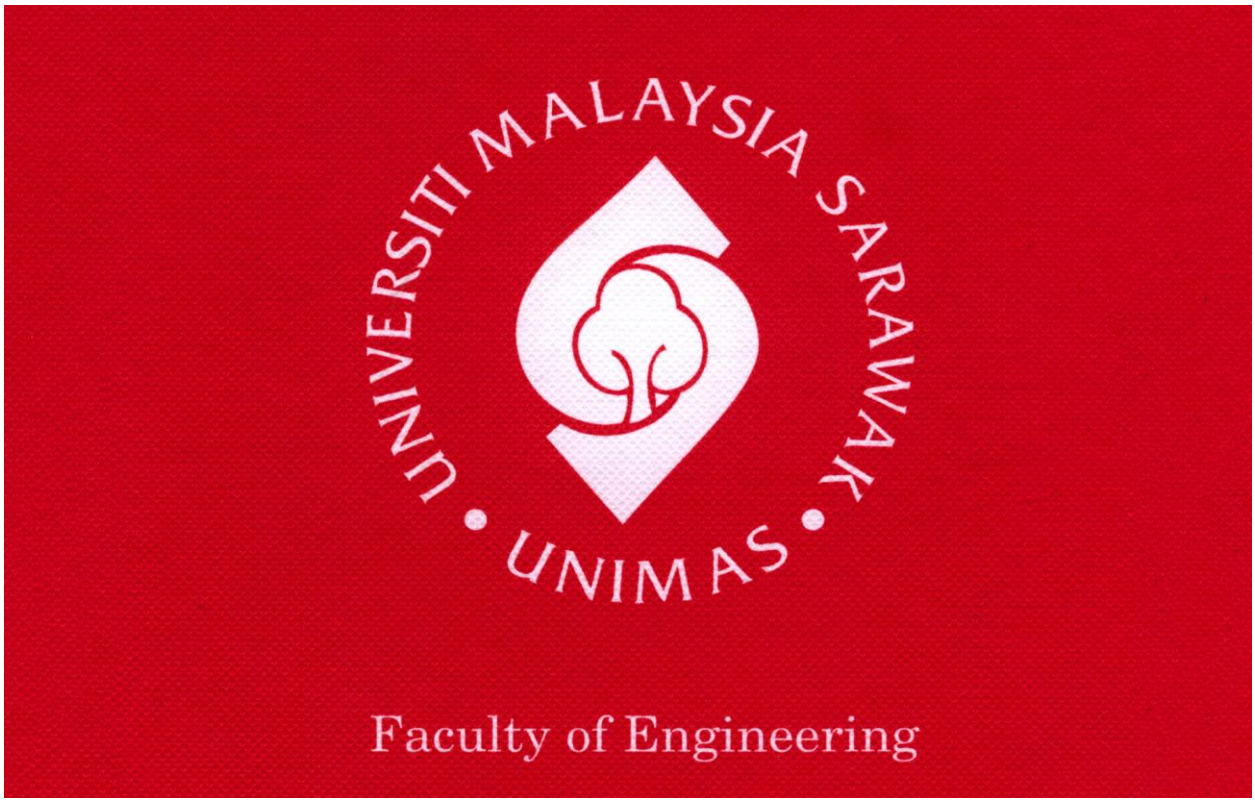

THE EFFECT OF ROAD GEOMETRIC (GRADIENT AND CURVE) ON FRICTION VALUE FOR INTERLOCKING CONCRETE PAVEMENT

Henry Sidie Anak Sulang

Bachelor of Engineering with Honours
(Civil Engineering)
2005

UNIVERSITI MALAYSIA SARAWAK

R13a

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Judul: THE EFFECT OF ROAD GEOMETRIC (GRADIENT AND CURVE) ON FRICTION VALUE FOR INTERLOCKING CONCRETE PAVEMENT

SESI PENGAJIAN: 2001 - 2005

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THE EFFECT OF ROAD GEOMETRIC (GRADIENT AND CURVE) ON FRICTION VALUE FOR INTERLOCKING CONCRETE PAVEMENT

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This project is submitted in partial fulfillment of the requirement for the degree of
Bachelor of Engineering with Honours
(Civil Engineering)

Faculty of Engineering
UNIVERSITY MALAYSIA SARAWAK
2005

To my beloved parent, near relative brothers and sister, friends and special for someone in my heart.

ACKNOWLEDGEMENT

Behind the development of this project, I would like to express my heartfelt gratitude to my supervisor, Ir. Resdiansyah Mansyur for the invaluable guidance and kindly support comments and advices throughout my final year project.

Word of appreciation is also due to Mr. Mohd Hafiz bin Mafadi and Mr. Haji Affandi bin Othman for the kind assistance offered in the period of my final year project carried out.

I would like to convey my warmest and thanks to my beloved family for me a financial supports and spiritual throughout the completion of this project. To all my friends and anyone who has in one way or another thank you very much for contributed towards the improvement and success of this final year project.

ABSTRACT

In general, the friction of interlocking concrete pavement is relatively high for all condition either wet or dry pavement. However, certain condition with a gradient and sharp curve involved, it could be dangerous in wet condition and might be given lower value of friction. This project was studied the effect of road geometric (gradient and curve) on friction value for interlocking concrete pavement at Jalan Reservoir Kuching and Jalan Dewan Bandaraya Kuching Utara (DBKU). The objectives of this project are to measure the loss of friction at interlocking concrete pavement and to evaluate the performance and their effect on vertical curve (gradient) and horizontal curve situation. This project was conducted by using "British Pendulum Tester". Analysis data from friction test was then used to determine friction factor and skid number. In order to get the friction value, five spot points along the road site for upgrade at Jalan Reservoir Kuching and four spot points for upgrade and downgrade were chosen at Jalan Dewan Bandaraya Kuching Utara (DBKU). Firstly, the result shown that the average of friction value at Jalan Reservoir Kuching was 46.6 and at Jalan Dewan Bandaraya Kuching Utara (DBKU) were 46.5 and 46.7 for upgrade and downgrade respectively, which is satisfactory in favorable circumstances as the data observation of FV was above 45 (TRL). Secondly, the friction factors values (FFV) were between ranges 0.2 to 0.39 at both locations, those values indicated the pavement surface is poor to fair (BS-5395). Lastly, the Skid Numbers (SN) for both locations was 31.2 and 31.0 and 31.3 respectively. Comparing to comment by Jayawickrama et al., 1996, the skid number indicated that monitor pavement frequently. As shown by the regression model generated, all the data from experimental concluded that friction value at interlocking concrete pavement increases with gradient on upgrades while on down grade concluded to the contrary.

ABSTRAK

Secara umumnya, jalan berturapkan konkrit dikaitkan dengan tahap geseran yang tinggi dalam semua keadaan iaitu sama ada basah ataupun kering. Walau bagaimanapun, sesetengah keadaan yang melibatkan kecerunan dan selekoh yang tajam akan menjadi bahaya semasa keadaan basah dan kemungkinan mempunyai nilai geseran yang rendah. Projek ini merupakan satu kajian terhadap kesan reka bentuk jalan (kecerunan dan selekoh) terhadap nilai gesaran untuk jalan berturapkan konkrit di Jalan Reservoir Kuching dan di Jalan Dewan Bandaraya Kuching Utara (DBKU). Matlamat projek projek ini adalah untuk mengira kehilangan geseran di jalan berturapkan konkrit dan menilai perlaksanaan serta kesannya terhadap selekoh (kecerunan) yang menegak dan juga selekoh di tempat mendaftar. Projek ini dijalankan menggunakan "British Pendulum Tester". Data yang dianalisis daripada nilai geseran kemudiannya digunakan untuk menentukan faktor gesran dan angka kegelinciran. Untuk mendapatkan nilai geseran, lima lokasi dipilih sepanjang Jalan menaik di Jalan Reservoir Kuching dan empat lokasi dipilih sepanjang Jalan menaik dan menurun telah dipilih di Jalan Dewan Bandaraya Kuching Utara (DBKU). Pertama, keputusan menunjukkan purata nilai geseran di Jalan Reservoir Kuching ialah 46.6 dan di Jalan Dewan Bandaraya Kuching Utara (DBKU) adalah 46.5 dan 46.7 untuk jalan menaik dan menurun, dimana ia adalah dalam keadaan yang memuaskan apabila nilai FV yang diperhatikan ialah melebihi 45 (TRL). Kemudian, nilai faktor geseran (FFV) adalah diantara linkungan 0.2 ke 0.39 di kedua-dua lokasi., dimana nilai tersebut menunjukkan permukaan Jalan adalah kurang baik ke serdahana (BS-5395). Akhirnya, angkan kegelinciran (SN) untuk kedua-dua lokasi ialah 31.2 dan 31.3. Jika dibandingkan dengan ulasan oleh Jayawickrama et al., 1996, angka kegelinciran tersebut menunjukkan jalan yang harus diperbaiki dengan kerap. Seperti yang ditunjukkan melalui model regresi, semua data daripada eksperimen dapat disimpulkan iaitu nilai geseran di jalan berturapkan konkrit meningkat dengan kecerunan semasa menaik sementara semasa menurun ia dirumuskan sebaliknya.

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T	-	Tangent length
R	-	Radius of segment of the circle
PC	-	the point at which the curve begins is known as the point of curve
PT	-	the point at which it ends is known as the point of Tangent
PI or V	-	the point at which the two tangent intersect is known as the point intersection or vertex
E	-	External Distance
Mo	-	Middle Ordinate
Δ	-	Deflection Angle
f	-	Friction factor
F	-	Friction resistance to motion in plane of interface
L	-	Load perpendicular to interface
SRV	-	Skid Resistance Value
SFC	-	Sideways Force Coefficients

CHAPTER 1

INTRODUCTION

1.1 Background

Consequently, engineers are continually facing the problem of maintaining and developing a pavement system to accommodate the movement of people in roadways. Since road are an essential part of everyday life, engineer are trying to fine other alternative design using sub-material standard to improve performance of the pavement. In term of that, automobile, truck, bus and airport traffic is growing every year, and the loads are getting heavier. The pavement would be distressed caused by the deficiencies in construction, materials, and maintenance and are not related directly to design. There are many types of pavement distress such as alligator or fatigue cracking, block cracking, joint reflection cracking from concrete slab, blowup, corner break, and faulting of transverse joints and cracks sometime exposed aggregate. These exposed aggregates flexible pavement is slippery when wet. In

term of year, skid resistance of concrete pavement can be decrease polished by tire and it effect slippery when wet and accident can occur. Today's highways often handle two to three times the traffic they were designed to carry.

According to Seiler L. (2004), the percentage of wet accidents is almost constant by all three categories such as weak curvature, strong curvature and junction. Various research has been done over many years to minimize the accident due to skid resistance or to define guideline for minimum skid resistance values. The factors must be considered when determining highway safety are skid resistance, pavement texture, roughness, and rutting; tire type, tread, and inflation pressure; vehicle speed, type, axle load, and brake slip; and environmental condition.

1.2 Road Pavement

The use of concrete pavement in Malaysian highways has just been introduced. Some assumptions made in the design and constructions were using foreign knowledge and experience. The pavement is the structure that separates the tires of vehicle from the underlying foundation material. In Europe pavements have traditionally been classified as flexible or rigid. Flexible pavement consists of three main layers, the bituminous surfacing, the base (or road base), and the subbase. Concrete pavements normally consist of two layers only, the concrete slab and the subbase.

Concrete pavements are by far the best long-term value because of their longer life expectancies, durability and minimal maintenance requirements. The rigidity of concrete pavements allows them to keep their smooth riding surface long after construction. Smoother pavements create safer, more comfortable riding surfaces. Concrete does not rut, so there is no hydroplaning and stress on an automobile's steering system. Concrete reflects 33 to 50 percent more light than asphalt, especially important for driving safely at night. Concrete actually gets stronger over time. After its first month in place, concrete continues to slowly gain ten percent strength during its life. Concrete can best withstand the heaviest traffic loads. There's no need to worry about ruts, shoving or washboard effects possible with asphalt pavements. Concrete pavements are easily textured during construction to create a surface that provides superior traction and a quiet ride. Depending on the system requirements, concrete pavements can be designed to last 40 years and more, thus making concrete the best long-term pavement solution. Concrete pavements frequently outlast both their designed life expectancy and traffic loads. The durability of concrete minimizes the need for extensive repairs or annual maintenance.

1.3 Skid Resistance

Skidding is a lost adhesion between a vehicle’s tires and the pavement surface, occur in many road accidents whether or not it is the actual causes of the accident. Over the years tire manufactures have done a lot of research into different

type of rubber and thread patterns to improve the safety of motor vehicles. Increasing and higher axle loads lead to growing stress of the road surface. Polishing of mineral aggregates may cause a lower skid resistance and dangerous reduction of traffic's safety.

Skid resistance is the force developed when a tire that is prevented from rotating slides along the pavement surface. Skid resistance depends on a pavement surface's microtexture and macrotexture. Microtexture is defined by smaller deviations in the surface, less than 0.2 in. (0.5 mm). Microtexture is the primary influence on skid resistance of vehicle tires traveling less than 25 mph (40 kph) that control contact between the tire rubber and the pavement surface. Macrotexture is defined as 0.2 in. (0.5 mm) scale texture of the pavement as a whole due to aggregate particle, which control the escape of water from under the tire and hence the loss of skid resistance with increased speed.

1.4 Measuring Pavement Skid Resistance

Highway engineer have researched ways to improve the skid resistance of road surface. With devices to measure skidding resistance, researchers then monitored changes during the life of the road pavement. It was found that skid resistance falls rapidly after road is opened to traffic but the rate of deterioration slows down, eventually settling to a constant value. This latter value is dependent on