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Judul: THE POLISHED STONE VALUE OF LOCAL AGGREGATES IN SARAWAK AND ITS PERFORMANCE ON SKIDDING RESISTANCE

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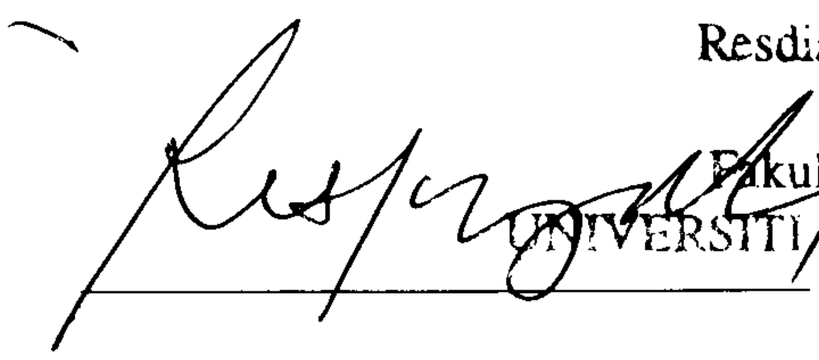

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THE POLISHED STONE VALUE OF LOCAL AGGREGATES IN SARAWAK AND ITS PERFORMANCE ON SKIDDING RESISTANCE

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This project is submitted in partial fulfillment
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Dedicated to my beloved family

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ABSTRACT

This study program was focused on the quality of aggregates in order to improve the Skid Resistance problem and look their performance in order to support road construction project in Sarawak. Two main types of aggregates has been used namely microtonalite and granite. Therefore, a total of six different quarries were selected such as Stigang Resources Sdn Bhd, Ang Cheng Ho Quarry and Penkuari Sdn Bhd for microtonalite sources meanwhile Samlimsam Quarry, Borneo Granite Sdn Bhd and Pulau Salak Quarry Sdn Bhd for granite. Two main tests were involves in the laboratory works namely Polishing of Aggregates and Skid Test. The aggregates were polished using Accelerated Polishing Machine according to the standards outlined in British Standard 812: Part 114: 1989. Meanwhile the measurement of Polished Stone Value for the sample was done using the British Pendulum Tester. The test results of (PSV) were compared with two standards or requirement suggested by Transport and Road Research Laboratory (TRRL) 1969 and Hosking 1992. Based on test results, the aggregates from certain quarry can be accepted as a superior quality of aggregates to improve skid resistance. Nevertheless, some of these quarry not achieved the maximum Polished Stone Value compared to the standard. Lastly, as a main quarry in Sarawak, the entire above quarry is expected able to supply sufficient aggregates for local usage especially in supporting to build a quality of road in Sarawak. Thus with the quality of aggregates, the skidding problem can be minimize especially in wet condition which is the one factor cause of accident on the roads.

ABSTRAK

Kajian ini difokuskan bagi mendapatkan kualiti batuan (*aggregates*) untuk meningkatkan nilai *Skid Resistance* batuan tersebut dan melihat sejauh manakah batuan ini mampu untuk menyokong kerja-kerja pembinaan jalan raya di Sarawak. Dua jenis batuan utama telah digunakan iaitu *microtonalite* dan *granite.* Sejumlah enam kuari berlainan lokasi telah dipilih seperti Stigang Resources Sdn Bhd, Ang Cheng Ho Quarry dan Penkuari Sdn Bhd untuk batuan *microtonalite* manakala Samlimsam Quarry, Borneo Granite Sdn Bhd dan Pulau Salak Quarry Sdn Bhd adalah untuk batuan *granite*. Dua ujian utama yang terlibat dalam kerja-kerja makmal iaitu *Polishing of Aggregates* dan *Skid Test*. Kerja-kerja *polishing* terhadap sampel batuan tersebut akan dilakukan dengan menggunakan *Accelerated Polishing Machine* berdasarkan garis panduan dalam British Standard 812: Part 114: 1989. Manakala pengukuran *Polished Stone Value* bagi sampel batuan telah dijalan menggunakan *British Pendulum Tester*. Keputusan bagi *Polished Stone Value (PSV)* batuan bagi setiap kuari yang diperolehi akan dibandingkan dengan standard atau keperluan seperti yang dicadangkan oleh Transport and Road Research Laboratory (TRRL) 1969 dan Hosking 1992. Berdasarkan keputusan yang diperolehi , batuan daripada beberapa kuari boleh dianggap sebagai batuan yang mempunyai kualiti yang tinggi supaya dapat meningkatkan lagi *Skid Resistance* batuan tersebut. Namun demikian terdapat juga batuan daripada beberapa kuari tidak mencapai tahap maksimum *Polished Stone Value* jika dibandingkan dengan standard dan keperluan yang sedia ada. Akhir sekali, sebagai kuari utama di Sarawak, ia adalah dijangka mampu membekalkan batuan yang mencukupi bagi kegunaan tempatan khasnya bagi memenuhi dan menampung keperluan pembinaan jalan raya yang berkualiti di Sarawak. Oleh yang demikian, dengan kualiti batuan yang ada maka masalah *Skidding* dapat dikurangkan terutamanya dalam keadaan yang basah dan licn yang mana ia merupakan satu faktor yang kerap menyumbang ke arah berlakunya kemalangan di jalan raya.

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NOTATIONS

°C	-	Degree celcius
°F	-	Degree farenheit
g/min	-	Gram per minute
h	-	Hour
in	-	Inch
kPa	-	Kilopascal
mm	-	Millimeter
ml	-	Mililiter
min	-	Minute
mph	-	Meter per hour
N	-	Newton
psi	-	Pound square inch
µm	-	Micrometer
%	-	Percentage
°	-	Degree

ABBREVIATIONS

AASHTO	-	American Association of State Highway and Transportation
AAV	-	Aggregates Abrasion Value
AC	-	Asphaltic concrete
ACV	-	Aggregates Crushing Value
AIV	-	Aggregates Impact Value
ASTM	-	American Society for Testing Materials
BPN	-	British Pendulum Number
BS	-	British Standard
BSI	-	British Standard Institution
CML	-	Central Materials Laboratory
CV	-	Commercial Vehicle
JKR	-	Jabatan Kerja Raya
NCHRP	-	National Cooperative Highway Research Program
PSI	-	Present Serviceability Index
PSV	-	Polished Stone Value
TFV	-	Ten Percent Fine Value
TRRL	-	Transport and Road Research Laboratory
SRV	-	Skid Resistance Value

CHAPTER 1

INTRODUCTION

1.1 Background

Recently Sarawak has many quarries that are actively producing various types of aggregates for construction industry especially in road construction. The numbers of quarries are expected to be increase from year to year due to the drastically development in Sarawak. The main locations of the quarries were located in some area in Kuching, Sibu, Bintulu, Miri and other areas in Sarawak. There are many quarries and its group classification of aggregates in Sarawak as shown in Table 1.1.

However, all aggregates which supplied by those quarries were without Polished Stone Value classification standard and recognition from any government's department especially Central Materials Laboratory (CML) under Jabatan Kerja Raya (JKR).

In road construction, there are many type of aggregates in Malaysia such as granite, microtonalite, limestone, basalt, quartzite and sandstone. However, the most commonly used in Sarawak as a surface course are granite and microtonolite. As we know the purposes of the pavement are to protect the underlying layer from deformation and also provide a good riding surface. The aggregates or stone road has generally been preferred pavement material for both purposes, used either on its own

Table 1.1 List of Aggregates from various sources in Sarawak

No.	**Location**	**Name of Quarry**	**Group Classification of Aggregates**
1.	Kuching, Bau	Sin Seng Ann Quarry	Limestone
2.	Kuching, Bau	Poh Kwang Quarry	Limestone
3.	Kuching, Bau	Paku Quarry	Limestone
4.	Kuching, Bau	Syarikat Tabai Sdn. Bhd.	Limestone
5.	Kuching, Lundu	Snibong Quarry	Sandstone
6.	Samarahan,Sebuyau	Borneo Granite Quarry	Granite
7.	Samarahan,Sebuyau	Samlimsan Quarry	Granite
8.	Kuching,Santubong	Pulau Salak Quarry	Granite
9.	Samarahan,Muara Tuang	Stigang Resources	Microtonalite
10.	Kuching, Batu Kawa	Ang Cheng Ho Quarry	Microtonalite
11.	Kakad Quarry, Kuching(16^{th} miles)	Agrowell Sdn.Bhd.	Microtonalite
12.	Ex.Pendu Quarry, Kuching(29^{th} miles)	Bestknown Quarry	Limestone
13.	Ex.JKR Quarry,Mile 22, Btu/Miri Road,Bintulu.	Sartop Corporation Sdn. Bhd.	Sandstone
14.	Kuching (21^{st} mile)	Akud Quarry	Limestone
15.	Kuching, 7^{th} miles	PPES Quarry	Microtonalite
16.	Kuching, 9^{th} miles	Penkuari Sdn Bhd	Microtonalite
17.	Kuching, 21^{st} miles	PPES Quarry	Limestone
18.	Samarahan,Sebuyau	PPES Quarry	Granite
19.	Kuching	Pludec Stone	Limestone
20.	Sebuyau	Sebuyau Quarry	Granite
21.	Bintulu	Similajau Quarry	Sandstone
22.	Bintulu	Thump Up Quarry	Limestone

(Source: Central Materials Laboratory (CML), JKR)

or in combination with other material. Basically, the common road has some structural layers or elements namely; surface course, base, sub base and sub grade. Basically, the general principle is that the required properties of an aggregate become more and more exact as the approach the surface of the road. In order to get the stability, the aggregates must be tested and analyzed to know if the rock is strong and suitable for usage of road layer especially for surface road.

In road structure, pavements are usually surfaced by asphalt mixture or Portland cement concrete. However the preparation for pavement surface involves constructions of the sub grade, sub base and base course as a foundation. Basically, the design of those components depends on the material to be used and the condition which the pavement must meet. The function of pavement structure is to distribute and reduce the high unit stress imposed by vehicles wheel on the surface of the road. As a load distribution function, the surface course of road pavement structure must be provide safe and smooth surface for road user and it must be tough to resist distortion under traffic.

Generally, pavements are classified as rigid, flexible and composite depending on how they distribute the surface load. This project will focus on the flexible pavement, which include asphalt concrete. Flexible pavement will distribute the load over a cone-shaped area under the wheel, reducing the imposed unit stress as depth increase. On the other hand, the rate of stress reduction varies with properties of the layer.

In early stage just after the construction, the condition and performance of the road is excellent. However, the performance of the road will decreased in term of the year especially for wearing course. The performance decrease varies with the time or aging of the road. The performance of the road can be measured in term of distress, serviceability and surface friction (Skid resistance).

Distress is very important criteria in pavement design. Distresses are caused by the deficiencies in construction, materials, and maintenance. Distress can be described by its general mechanism, level of severity (low, medium and high) measurement criteria. There are many types of distress such as rutting, cracking, patching and other distresses.

Serviceability means, the ability of a specific section of pavement to serve traffic in it existing condition or road surface. The serviceability can be determine using the Present Serviceability Index (PSI) developed at the AASHTO Road Test, which based on pavement roughness as well as distress condition and using roughness index based on the roughness only.

Surface friction is one of the other criterions to measure the performance of the road. Surface friction can be defined as the force developed when a tyre that is prevented from rotating slides along the pavement surface. Adequate surface friction must be provide on a pavement in order loss of control does not occur in all condition especially when the pavement is wet. Furthermore, the decreasing of skidding resistances is caused by insufficient of surface friction. Loss of skidding resistance will encourage skidding accident. Therefore, skidding resistance must be

measure to determine the coefficient of friction between pavement and tyre or any vehicles wheel. Skidding test is needed for aggregates that will be used before the implementation of the road.

The important of rock or aggregates tests to maintain and analyze the skidding resistance from any polishing action of a pneumatic tyre under condition similar to those occurring on the road surface. There are many types to test the aggregates namely; Aggregates Crushing Value (ACV), Ten Percent Fine Value (TFV), Aggregates Impact Value (AIV), Aggregates Abrasion Value (AAV), Magnesium Sulphate Soundness Test, but only Polished Stone Value (PSV) is covered for Skidding Resistance of aggregates. The Polished Stone Value (PSV) test will be used to check the polishing resistance and its performance on skidding resistance.

1.2 Polished Stone Value (PSV)

Polished Stone Value (PSV) test is very important for aggregates used in road construction especially for road surface. The purpose of PSV test is to measure its resistance to the polishing effect of vehicle tyre under similar road surface conditions. Inside the road layers, the surface of the road consist largely of road stone. The state polish of the sample will be one of the major factors affecting the surface to skidding.

For example, when an aggregates too much under the polishing effect of vehicle tyre, the road surface very slippery especially in wet condition. Then number of skidding on the road increase. Generally, the actual relationship between Polished Stone Value (PSV) and Skidding Resistance will vary with the traffic conditions, type of surfacing and other factors.

1.3 Skid Resistance

The Skid Resistance Measurement is an important to measure texture depth and skid resistance of road surface and to estimate the vulnerability of an aggregates to polishing under traffic by determining its Polished Stone Value (PSV).The phenomenon of skidding, for example loss of adhesion between a vehicle's tyre and the road surface occur in many road accidents whether or not it is the actual cause of the accident. The Skid Resistance Measurement is done using British Standard Pendulum Skid Resistance Tester.

1.4 Objectives

The study aims in this project is to find the Polished Stone Value (PSV) and its performance on Skidding Resistance for local aggregates sample from selected quarries in Sarawak. The focus objectives of this study are listed as follows:-

- To determine the PSV of aggregates from certain quarries in Sarawak in accordance with British Standard 812:Part114:1989.

- To compare of PSV in term of difference aggregates and quarries.
- To find the performance of aggregates on Skidding Resistance.

1.5 Scope of study

The scope of study will be focus on the research and testing of the Polished Stone Value (PSV) of local aggregates in Sarawak especially for granite and microtonalite. This studies also to checks its (aggregates) performance on Skidding Resistance. All the standards and schedules will be conducted based on and compliance with British Standard 812: Part 114: 1989.

The final value of PSV will be used as a guideline for classification standard of local aggregates in road construction in Sarawak.

CHAPTER 2

LITERATURE REVIEW

The main purpose of this chapter is to give more understanding regarding the local aggregates for road surface. This chapter also identifies the Polished Stone Value (PSV) and performances of various aggregates on skidding resistance.

2.1 Pavement Material

Basically, the structures of the road consist of three layer; sub base, base and surface course. Aggregate is one of the most important pavement materials especially for surface course. The surface course is the top course of an asphalt pavement where exposed with friction from vehicles tyre. Aggregate is also needed as an ingredient for mixing process. On the other hand, aggregate is very important to protect skid accident occurs in all condition especially when wet.