

The Study of Highway Maintenance Works In Selangor

Abdulbaset Abdulrhman Abushnaf¹, Amiruddin Ismail²

Lecturer of Department Civil Engineering, Higher Institute For Comprehensive Professions , BaniWalid, Libya¹

Associate Professor, Department of Civil Engineering, Engineering Faculty, UKM, Bangi, Malaysia²

ABSTRACT:The major towns are accessible by roads in the state of Selangor. The road networks are expanding at a slow rate. Hence, the maintenance of existing roads is of utmost importance. But it was found that some of the roads are badly deteriorated due to poor maintenance of the roads. A study was carried out with the objective to identify the main types of defects that frequently occur, the factors that cause the defect of roads and also to identify the methods used for road repair. This study was carried out in the district of Bangi, Selangor and involved the roads. Under the care of Public Work Department and maintained by Road care(M) Sdn. Bhd. A total of 40 questionnaires were distributed and 37 of the questionnaires were received. The study was also carried out by interview. The data is analysed using average index method and statistics. From the study the main types of defects that frequently occur are potholes, block cracks, leveling and rutting. The factors that cause the defects of roads are heavy traffic and excessive environmental condition.

KEYWORDS: Improve highway maintenance works, Rutting.

I. INTRODUCTION

Malaysia is formed by the Malay Peninsular and the East Malaysian states of Sabah and Sarawak on the northern coast of Borneo in 1963. The peninsular which is located at the southern Asia bordering by Thailand while northern one-third of the island of Borneo, bordering Indonesia and Brunei make the Federation of Malaysia accessible from other countries by sea, air and road. An estimation in year 2001 shows that the road network in Malaysia covers 65 877 km with 51 318 km paved roads and, 14 559 km left unpaved. In addition to these national and main regional roads, Malaysia has thousands of kilometres of local roads that are maintained by local jurisdictions etc. The requirement of road begins since the invention of wheel in Samaria in 3000 Bc. Since then, the road construction has slowly evolved over a very long period from the bare earth or soil surface roads to the highway with both flexible etc. Federal roads used are to connect between main cities and the entrance throughout the country. This kind of road system is constructed and being maintained to the initial condition using the direct allocation from federal government under the federal Public Works Department. [1]. The basic objective of road maintenance is implicit in the word itself. It is done to ensure that the road that has been constructed, or improved, is maintained in its original condition. It is accepted that over the life of the road it will deteriorate due to factors with which maintenance activities cannot deal. Nevertheless maintenance is intended to begin on the first day after the road improvement works are completed. [2]. Even governments have learnt to do more with less. Privatization offers a solution to improve quality and save money. Cities, districts, states, and the federal governments privatize road and highway maintenance to achieve the common advantages of privatization, as summarized with reference to Segal, et al [3]. The current available proof of aging is by measuring the bitumen viscosity. However Januszke et al (1992) caution that single point measurement of bitumen property to justify aging is limited unless backed up by considerable empirical experience and knowledge of the bitumen types involved. [4]. Research in crack sealing advances into finding the cheapest and effective type of sealant and finding the best ways of sealing cracks. Research undertaken by the Strategic Highway Research Group (SHRP, 1992), in the U.S.A. is currently undergoing in using robotics for crack sealing operations. [5], Surface dressing has

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

been commonly used as a wearing course on low volume roads. It is a suitable resurfacing technique on most surface failure on these roads. The potential use of surface dressing is not limited to improve surface distress. High bitumen film thicknesses improve resistance against ageing. The layer of bitumen may seal cracks. [6]

Thin hot mix asphalt is a minimum thickness of asphalt normally less than 25 mm thick laid using customary equipment. Any type of hot asphalt mix or modified mix can be used. The thin asphalt layer provides for non-structural purposes mainly to correct surface deficiency.

Thin hot mix can be applied at areas subjected to low traffic loading and deflection level. It is not meant to correct structural failures such as cracking and severe rutting. Surfacing that suffers from polishing, stripping, bleeding can be overlaid with thin asphalt.

Porous thin hot mix can also be used. High voids in the mix allow water to drain laterally. Removal of water through this mix is rapid. Water splash and spray are substantially reduced when driving in wet conditions on this surface. Improved surface friction characteristic makes this mix suitable for wet roads.

II. METHODOLOGY OF STUDY

The methodology flowchart as shown in briefly explains the methodology of this study. The most important part of this study is the data collection. The data are divided into two categories; there are primary and secondary data.

1. Primary data refer to all the real data collected from the study area. There are four types of data used in this study which are: defects that occur which maintenance are required, factors cause the defects, maintenance activities treatments and budget allocation for maintenance according to types of roads, section or activities carried out. The data is collected through questionnaires, interviews and site visit.
2. secondary data can be obtained through the literature review from the published material such as books, journal, conferences proceeding, newspaper etc..
3. After collecting arranging all the required information through questionnaires, interview, site visit, and literature review, all the data will be analyzed to generate accurate result which can represent and draw conclusion to the research objectives. The data are analyzed using the average index method and statistic.
4. The average index is counted according to the following formula [16]:

$$\text{Average Index} = \frac{\sum a_i x_i}{\sum x_i}$$

Where

a_i = constant expressing the weight given to i

x_i : variable expressing the frequency of respondent, for $i: 1, 2, 3, 4, 5$

Average index method is used to identify deterioration of the road and to study the maintenance management system. The categories of scale are:

1= very frequent	1.00 < min index	1.50
2=frequent	1.50 < min index	2.50
3= average	2.50 < min index	3.50
4= less frequent	3.50 < min index	4.50
5= least frequent	4.50 < min index	5.0

5. Conclusion will be made out according to the research. Via the conclusion, recommendations will be given for future study.

III. DATA ANALYSIS

Raw data from Public work Department, Selangor Municipal Council and the Concession company Roadcare(M) Sdn.Bhd. is analyzed and identify major periodic maintenance works that are carried out. The collected data is also used to analyze and identify the incurred costs for periodic maintenance works carried out by the concession company Roadcare(M) Sdn. Bhd. And routine maintenance by public Work Department Selangor.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

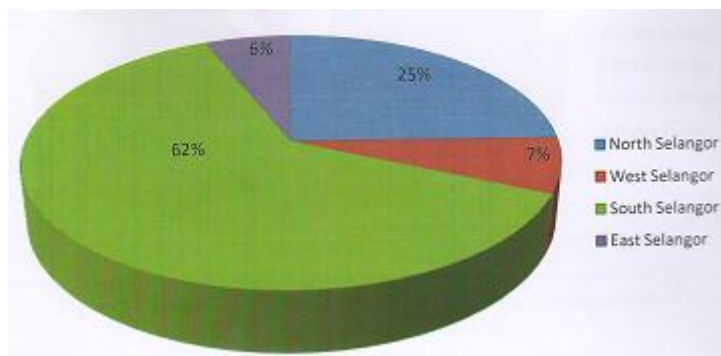
1. Periodic maintenance

Table 1 explains the length involved under periodic road maintenance that the concession company undertook in 2006, 2007, and 2008. Firstly, the scattered data is grouped and categorized into 11 types of works as carried out by the company and both of the agencies. Then the length for every type of work for each state is calculated and analysed

Activity	2006		2007		2008	
	km	%	km	%	km	%
Mill and Pave	12.81	6.40	14.5	7.20	20.15	10.07
Pave	5.15	2.74	0.00	0.00	3.00	0.50
Regulate	0.00	0.00	0.00	0.00	0.00	0.00
Mill, Regulate & Pave	0.00	0.00	0.00	0.00	0.00	0.00
Reconstruct & Pave	8.19	4.36	24.00	12.00	0.00	0.00
Scarify & Pave	0.00	0.00	0.00	0.00	0.00	0.00
Scarify, Regulate & Pave	0.00	0.00	0.00	0.00	0.00	0.00
Scarify, Raise & Reconstruct	0.00	0.00	0.00	0.00	0.00	0.00
Regulate & Pave	22.48	11.96	4.00	2.00	28.20	14.10
Reconstruct, Scarify, Regulate	0.00	0.00	0.00	0.00	0.00	0.00
Strengthen & Pave	0.00	0.00	0.00	0.00	16.25	8.12
Total	48.63	100	42.5	100	67.6	100

Source: Roadcare (M) Sdn Bhd.

Fig1 Demonstrates the length of roads that was maintained periodically for each of the four areas as with in the concession area. It can be seen that periodic maintenance works was carried out the most in the area of South Selangor with a 62% total length of road maintained.



2. Incurred costs for periodic maintenance

Table 2 Costs incurred in carrying out periodic maintenance works for 2006, 2007 shows that 'Mill and Pave' accounts for the most incurred cost in 2006 with an amount of RM 6,450,000. This is followed by 'Reconstruct and Regulate' which accounts for RM 5,320,000, and 'Regulate and Pave' amounting RM 0,870,000

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

Activity	Cost (RM)	Percentage (%)
Mill and Pave	6.45 million	59
Pave	0.00	0.00
Regulate	0.00	0.00
Mill, Regulate &Pave	0.00	0.00
Reconstruct & Regulate	5.32	35.10
Scarify & Pave	0.00	0.00
Scarify, Regulate & Pave	0.00	0.00
Scarify, Raise & Reconstruct	0.00	0.00
Regulate & Pave	0.87	5.90
Reconstruct, Scarify, Regulate	0.00	0.00
Strengthen &Pave	0.00	0.00
Total	12.64	100

Source: Roadcare(M) Sdn.Bhd

Activity	Cost (RM)	Percentage (%)
Mill and Pave	7.63 (million)	30.50
Pave	0.00	0.00
Regulate	0.00	0.00
Mill, Regulate &Pave	0.00	0.00
Mill, Scarify, Regulate & Pave	0.00	0.00
Reconstruct & Regulate	9.8	58.02
Scarify & Pave	0.00	0.00
Scarify, Regulate & Pave	0.00	0.00
Scarify, Raise & Reconstruct	0.00	0.00
Regulate & Pave	0.72	5.47
Reconstruct, Scarify, Regulate	0.00	0.00
Strengthen &Pave	0.00	0.00
Total	18.15	100

Source: Roadcare(M) Sdn.Bhd

Table 3 Costs incurred in carrying out periodic maintenance works for 2008, shows that 'Mill and Pave' costs the most in 2008 with a cost of RM5,940,000 followed by 'strengthen and Pave' with a cost of RM 7,400,000. These three activities accounts..7,400,000, and 'Regulate and Pave' with a cost of RM 0,460,000.

Activity	Cost (RM)	Percentage (%)
Mill and Pave	5.94 (million)	41.8
Pave	0.40	2.8
Regulate	0.00	0.00
Mill, Regulate &Pave	0.00	0.00
Mill, Scarify, Regulate & Pave	0.00	0.00
Reconstruct & Regulate	0.00	0.00
Scarify & Pave	0.00	0.00
Scarify, Regulate & Pave	0.00	0.00
Scarify, Raise & Reconstruct	0.00	0.00
Regulate & Pave	0.46	3.23
Reconstruct, Scarify, Regulate	0.00	0.00
Strengthen &Pave	7.40	52.10
Total	14.20	100

The activity 'Strengthen and Pave' incurred highest cost in 2008 with an incurred cost amounting to 52.10 percent of the total costs incurred for that year.

Fig 2 indicates the rapid decline of the incurred costs for periodic maintenances since the privatization from RM2.2 million in year 2006 to RM 3.1 million in year 2007, to RM 2.5 million in year 2008. The 20 percent decrease in the annual periodic maintenance cost for the year 2006 and a further 31 percent decrease in year 2007 are within the government's control.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

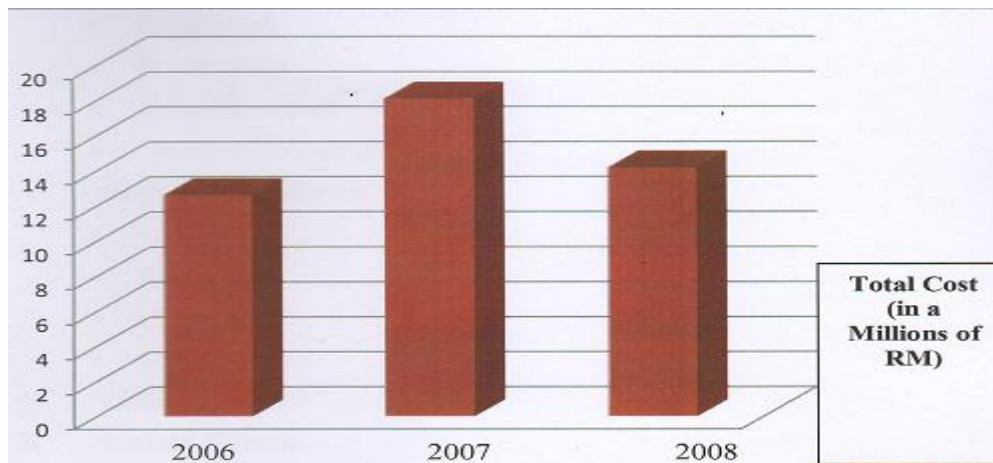


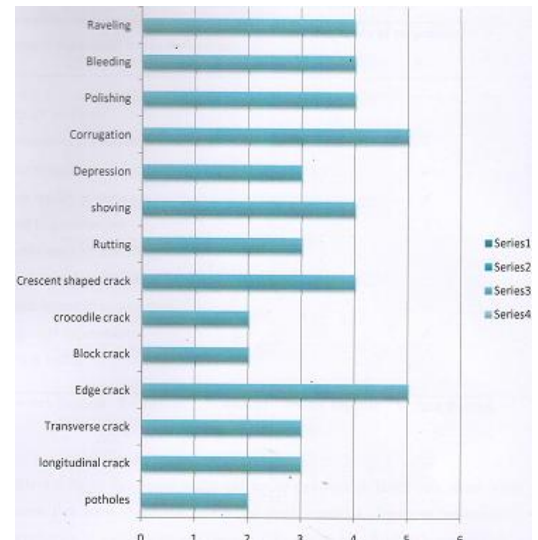
Figure 2 Annual Periodic Maintenance Costs Source :Roadcare (M) Sdn.Bhd

3. Type of defects occur on the roads in Selangor.

Table 4, Fig 3 the defects occur on the roads will greatly affect the quality of the road. To identify the frequency of the occurring and severity of each type of defects on the roads will surely help to increase the effectiveness of maintenance work.

Types of defects frequently occurs	frequency of respondents				
	1	2	3	4	5
Potholes		✓			
Cracking					
Longitudinal crack			✓		
Transverse crack			✓		
Edge crack					✓
Block crack		✓			
Crocodile crack		✓			
Crescent shaped crack				✓	
Surface Deformation					
Rutting			✓		
Shoving				✓	
Depression			✓		
Corrugation					✓
Surface Defect					
Polishing				✓	
Bleeding				✓	
Raveling				✓	

1=very frequent 2=frequent 3= average 4= less frequent 5= least frequent
Source: Roadcare(M) Sdn.Bhd



IV. FACTORS CONTRIBUTE TO THE DEFECT OF THE ROADS

From the literature review, there are nine factors contribute to the defect of the roads. a questionnaire study on this purpose had been distributed. The respondents are required to fill up the questionnaire and arrange the factors according to the frequency of occur. The most frequently contribution factor will be rank as five [5].

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

Table 5 shows that heavy traffic and act of god such as heavy rain, flood is the factors that most frequently affect the road condition. Improper maintenance, imperfection in construction and design of the road is also frequently contributed to the defects of the road. Low quality in materials used in road construction and inefficiency of controlling and monitoring are in the category of average.

Factors contribute to the deflection	frequency of respondents				
	1	2	3	4	5
Design problems					✓
Excessive environmental condition				✓	
Due to accident				✓	
Low quality in materials used in construction				✓	
Inefficiency of controlling and monitoring by authorities					✓
Imperfection in construction				✓	
Improper maintenance				✓	
Heavy traffic		✓			

1=very frequent 2=frequent 3= average 4= less frequent 5= least frequent
Source: Roadcare

Table 6 The defects of the road should be repair to ensure that the road reach the serviceability level. There are of methods which can be used for the repair purposes.

Method used to repair the road defects	frequency of respondents				
	1	2	3	4	5
Rejuvenating				✓	
Crack sealing and filing		✓			
Patching	✓				
Thin bituminous overlays				✓	
Resurfacing		✓			
Retread			✓		
Repave and re-mix		✓			
Mix-in-place				✓	
Mix-in-plant		✓			
Reconstruction			✓		

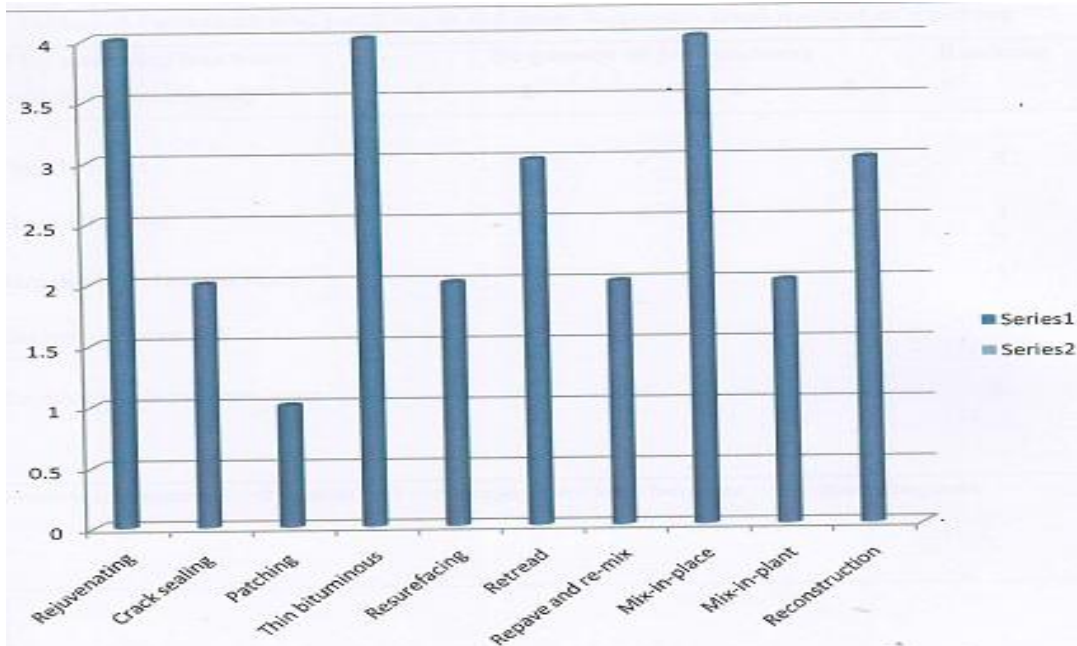
1=very frequent 2=frequent 3= average 4= less frequent 5= least frequent
Source: Roadcare

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

Fig 4 The defects of the road should be repair to ensure that the road reach the serviceability level. There are many types of methods which can be used for the repair purposes. However, the application of the methods are limited by several factors such as the cost required, man power, the available machinery, technique required etc'



Analysis from the collected questionnaire had been done and the frequency of the methods being used to repair the defects of the roads by Public Work Department district of Bangishow in Table 6 and Figure 4 it can be seen that patching is the most frequently used method in Public Work Department in the district of Bangr.

6. Factors causes patching as the most frequently used methods to repair the road defect.

Table 7 Five factors had been identified to determine why patching had been used most widely in repairing of the road defects. The staffs from the Public Work Department: Selangor had been asked to fill a questionnaire by giving ranking to the factors.

Why patching has been used most frequently	frequency of respondents					Ranking
	1	2	3	4	5	
The cheapest			✓			3
Most effective			✓			4
Require the shortest time		✓				1
Easiest to carry out		✓				2
Require the least resources			✓			5

1=very frequent 2=frequent 3= average 4= less frequent 5= least frequent

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 12, December 2015

IV. CONCLUSION AND RECOMMENDATION

From the data analysis, it is concluded that the study that being executed was successful and the achievement of the study can be itemized as following as Road's maintenance, road defect and level of Satisfaction of road using.

A. Road maintenance management

From the study it can be concluded there are advantages and disadvantages of road maintenance management carried out by each of the agencies involved. The study also shows that the road users are more prefer on the road maintenance by the internal workers rather than contracting out the maintenance work.

B. Road defect.

The types of defects identified from this study are:

, Crocodile cracks , Surface deformations , Rutting , Corrugation , Depression .

C. Level of satisfaction of road users

The average index of 3.53 compared to 3.73 resemble that the road user belief that MPK's internal workers are more skilled than contractors in carrying out road maintenance work.

In terms of monitoring, an average index for the client beliefs that the maintenance activities by the contractor or internal workers are neither sufficiently nor insufficiently monitored shows that the average index 3.43 compared to 3.43 where the road user preferred maintenance by MPK's internal workers (Reference).

D. Recommendation for future study

- 1) To study the deference of the maintenance system'
- 2) The major improvements that was experienced after privatization as compared to before privatization.
- 3) The challenges of implementing successful privatization project 'normally used in developed nations.
- 4) The quality of road network before and after the privatization.
- 5) Road user satisfaction throughout urban and rural area'
- 6) Centralization of appointment of maintenance contractor from State Government.
- 7) Standardization of schedule of rate for road maintenance.
- 8) Loose materials (usually aggregate) that "ravel" from the surface edges of the pavement, resulting in depressions which may fill with moisture and loose aggregate which may pose problems'

Solutions – Prevention

- Timely preventive maintenance with one of the cures listed.
- Polymer modified asphalt binder
- Clean aggregates
- Material transfer devices
- Good compaction

REFERENCES

- [1] Chalmers, J. , Managing Projects. Hong Kong: Grolier International Inc ,1999.
- [2] Paterson, W.D.O. , Road Deterioration and Maintenance Effects: Models for Planning and Management. 1st ed .Washington D.C.: The World Bank , 1987.
- [3] Colonna, P., Fioretti, G., Fonzone, A', & Sasso, S. , New Approaches 'in Road Maintenance Planning: The Global Road Maintenance System (GRMS). Polytechnic University of Bari ,2001 .
- [4] Gibbon, H. , A Guide for Divesting Government –Owned Enterprises. How to Guide No. 15, Reason Foundation ,1996 .
- [5] Lantran, J.M. , contracting out Road Maintenance Activities - The New Role of the Road Authority' World Bank, Washington'USA', 2000.
- [6] Parkman, C.C., Madelin, K.B. ,Robinson R., & Toole, T. , Developing Appropriate Management and Procurement Approaches for Road Maintenance. University of Birmingham, UK ,2000 .
- [7] Jomo, K.S. ,Malaysia's privatization experience ,1995 .
- [8] Macrae, N. ,A Future History of Privatization. The Economist ,1991.
- [9] Thompson, P. & Sanders, S. ,Partnering Continuum. Journal of Management in Engineering . Vol.14 ,1998 .
Turner, J.R . , "The Handbook of Project – Based Management " England ,1991 .