Road Surface Management System (RSMS)- A case study on Polytechnic Kuching Sarawak road

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Abstract
The Road Surface Management System (RSMS) is a methodology intended to provide an overview and estimate of a road system's condition and the approximate costs for future improvements. RSMS is implemented utilizing a computer based software package which provides information on the condition, traffic, and importance of roads in a town to create a long term maintenance program. This methodology was use to provide road system’s condition and overview at PKS road because it will help the Maintenance Unit to use the record and data to prepare budget allocation every each year for road maintenance. It will only need to be update annually and lead to decreasing the cost for maintaining and rehabilitant the road for much more years. The RSMS software also includes work orders to document completed work and its associated costs.

Key word: “Road Surface Management System”, road system condition, road maintenance, cost

Introduction
Road surface management is the application of pavement management principles as a means of determining the road condition and the cost for maintaining the whole system of the road. RSMS are available to manage data and prepare reports. These systems are generic so that they are applicable to a wide variety of municipalities. RSMS is implemented utilizing a computer based software package which provides information on the condition, traffic, and importance of roads in a town to create a long term maintenance program. The RSMS system is based on the Road Condition Decline Curve, as shown below which illustrates that roads in good condition cost less to maintain than those in poor condition. Routine maintenance on roadways in generally good condition is often the most important strategy to consider.

Computer use is required for each phase of RSMS; however, all the work does not necessarily have to be on the same computer. Developing the road inventory file and generating the RSMS reports can be completed on any compatible personal computer. Road surface condition survey information is input by using a manual form that will be key-in to RSMS software before generating any report.

Problem Statement
This research of case study was done on Polytechnic Kuching Sarawak road. Since it was
opening in the year of 1987, there was no record or information gained on the road surface in PKS. As the traffic and importance was low, there is no further action taken on small road distress that occur on the road. But, we must take into consideration the long term effect by the road distresses as explain by the Road Condition Decline Curve, roads in good condition cost less to maintain than those in poor condition. Somehow we need to have the record on road condition in PKS for at least routine maintenance every year. According to the American Association of State Highway and Transportation Officials (AASHTO), every $1 spent to keep a road in good condition avoids $6-14 needed later to rebuild the same road once it has deteriorated significantly. Investing too little on road repair increases these future liabilities.

Objective

The goal of this project is to provide a procedure for the engineering evaluation of flexible roads pavement. This project hopefully will achieve some of the objectives as below. The objectives are:

1) To establish Polytechnic Kuching Sarawak Roads information data.
2) To run and analyze the road information data using Road Surface Management System (RSMS) software.

Scope of study

This case study was done at Polytechnic Kuching Sarawak Road, in the entire campus. It was located at KM22, Matang Road, Kuching, Sarawak. The total length of the PKS Roads are 5.54km length. It were divided into several section as the road doesn't have a specific name for the divided section. It's begin from the entrance (guard station) until the staff houses at the end of the road. As it established in 1987, the pressure on its land-use mounts up from year to year. The development of infrastructure and expansion of its area gives rise to the need for transport of staff, students and visitors from outer fringe of Polytechnic Kuching Sarawak (PKS) into the inner core of the campus and also better traffic circulation within the campus. From a single road, it becomes more connection from place to place over the years until now.

Picture 1 : Polytechnic Kuching Sarawak (2009)

Literature review

Malaysia, as a develop country has constructed and maintained an extensive road network for many decades. Nowadays, with the complex and mature network, the government is faced with the challenge of improving its management technique to deal with traffic loading beyond original design thresholds. The main problem which give rise to the defectiveness on the road surface are as follow:

1) Pavement on road surface cracks due to traffic loading.
2) Environmental problems such as heavy rains and flood which can cause damage at road surface.

Besides this problem, the management team should meet with technical problem in road maintenance based on information that is recorded in form 'surface condition survey'. It is include:

1) Difficulties in decide the actual location of cracks in planning decision making.
Due to this situation and problem, other side problem will be rise such as increasingly the cost of maintenance, problem in doing the maintenance work for planning to increase the status of the road system and pollution which is caused by the defect on the road surface such as crusher run stone. In this way, dealing with this problem and to reducing it, the lagging action should be taken to facilitate the management system. Therefore, one automated system is needed to support the pavement information and road surface information system.

**Polytechnique Kuching Sarawak (PKS) Campus Road Pavement Condition**

With the growth of PKS infrastructure and development over the years, it will increased the traffic flow and the road must be able to withstand the accelerated loading from traffic. The existing transport network, pavement condition and facilities which was adequate for the needs of the campus of the past, becomes more overloaded to be adequately capable of handing the newly created and ever-growing transport demand. Surface distress of pavement may be observed at certain section of the road. As such, serious failures and prolonged delay in rehabilitation may result in costly resurfacing. That is why Road Surface Management System (RSMS) for PKS is needed in this short while.

Road surface management systems use three categories of data: (a) road inventory, (b) surface condition survey, and (c) repair alternatives and associated costs. Road inventory and condition survey results are entered by the user. Complete editing of the road inventory file allows users to update, and limited editing capability of the condition survey results restricts adjusting of field data. Users should have the option of entering or adjusting repair practices and associated costs to represent their maintenance practices and costs. A pavement service index can be calculated to denote the quality of a road network. Decision trees can be used to associate repair practices with surface deterioration characteristics; users should have the option of adjusting the trees to represent their decision-making practices.

**Research Methodology**

Road Management System (RSMS) is a management system for road maintenance used to provide effective, safer roads, cost effectively. Implementation of RSMS principles, municipalities may reduce long term maintenance costs, improve road quality, develop short and long term repair plans, justify budgetary request and the establishment of capital reserve funds.

The average road has a lifecycle of approximately 15 years. Implementing planned maintenance and repairs, at critical points during the roads’ lifecycle, will save on long term maintenance cost. Studies made on the “Lifecycle of a Road” indicate for each dollar of repair cost delayed, it will cost four to eight times as much to rebuild the road. The same study showed that with scheduled repairs, the result is a delay in the need for a complete rebuild of roads, by as much as ten additional years beyond the lifespan of roads. Each time the decisions to defer road maintenance is made, the effect shortens the lifecycle of roads and you never catch up.

As part of the RSMS process, a very thorough inventory and condition assessment was completed of all roads maintained by PKS. The analysis of the data produced a report with recommended repairs for each road. From this report a management plan for repairs and maintenance was completed.
The RSMS contains five components:

**Road Inventory:** The inventory contains essential information for the RSMS management process. Users divide the road network into sections based on surface condition and changes in geometry. Information is gathered through historical data analysis and a windshield study.

**Road Surface Condition Survey:** RSMS measures road condition in terms of the extent of surface distress and drainage characteristics.

**Priority Analysis:** Based on surface condition, the RSMS program categorizes each road section and determines a strategy for its repair. It then calculates a priority value for each road section.

**Repair Selection:** The RSMS program contains information on many specific road repairs. Users can also customize the program to utilize repair strategies that are favored in a particular area. RSMS provides a short list of repairs appropriate for each road section. When users select a specific repair, RSMS calculates the cost for that section and the total cost for the network.

**Planning & Budget Preparation:** Users can plan repairs in single or multiple years by selecting different repairs and analyzing the effect on the total cost. The RSMS software also includes work orders to document completed work and its associated costs.

**Result and Analysis**

For PKS Roads, the type of surface that we have is paved road for the entire network. The 7 paved roadway distresses are as follows. The first 6 distresses are distresses of the paved surface; the 7th is drainage-related.

1) Alligator cracking
2) Longitudinal and transverse cracking
3) Edge cracking
4) Patching, potholes, and delamination
5) Roughness
6) Rutting
7) Roadside drainage

The severity of each of the 7 paved distresses is estimated and recorded on a none/low/medium/high scale. The various levels of severity for each ranking are described and depicted later in this manual. Pictures are included to provide visual examples of each paved distress severity level. Gravel distresses are not evaluated for severity, only extent. Like severity (paved roads only), extent is also measured on a none/low/medium/high scale, but the scale is the same for every distress, as follows:

1) none—no distress is visible
2) low—the distress covers less than 10% of the road section.
3) medium—the distress covers between 10% and 30% of the road section.
4) high—the distress covers more than 30% of the road section.
Table 1: The PKS Road Distresses and total up percentage

<table>
<thead>
<tr>
<th>Road Distresses</th>
<th>Total up Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alligator cracking</td>
<td>5% (Low)</td>
</tr>
<tr>
<td>Longitudinal/Transverse cracking</td>
<td>1.2% (Low)</td>
</tr>
<tr>
<td>Edge cracking</td>
<td>25% (Low)</td>
</tr>
<tr>
<td>Patching/Potholes/Delamination</td>
<td>4.3% (Low)</td>
</tr>
<tr>
<td>Roughness</td>
<td>35% (Medium)</td>
</tr>
<tr>
<td>Rutting</td>
<td>0.8% (Low)</td>
</tr>
<tr>
<td>Drainage</td>
<td>6.8% (Low)</td>
</tr>
</tbody>
</table>

Table 2: The estimate cost for repair and maintenance works at PKS Roads

<table>
<thead>
<tr>
<th>Road Distresses</th>
<th>Cost (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alligator cracking</td>
<td>850</td>
</tr>
<tr>
<td>Longitudinal/Transverse cracking</td>
<td>340</td>
</tr>
<tr>
<td>Edge cracking</td>
<td>4400</td>
</tr>
<tr>
<td>Patching/Potholes/Delamination</td>
<td>1200</td>
</tr>
<tr>
<td>Roughness</td>
<td>6000</td>
</tr>
<tr>
<td>Rutting</td>
<td>450</td>
</tr>
<tr>
<td>Drainage</td>
<td>900</td>
</tr>
</tbody>
</table>
Conclusion

From the road inventory and road condition survey result obtained in the RSMS software, it is shown that the pavement in PKS roads suffer a variety of cracking, low severity of rutting, roughness and some defects that appear in some of the road segment. The total Pavement Condition Index (PCI) for the current year is 97%, that is in a good condition and if the recommended repair works is done, then the PCI value for the whole network can increases until 99% (very good condition). There are five main factors that influence much of this variation in the performance life of a pavement. It is important to understand these factors to clearly evaluate the present condition of the pavement and determine the possible affects of any pavement distress that may have occurred. The five main factors are traffic, water, sub-grade, construction quality and maintenance. Overall, the PKS Roads for the year of 2012 is in a good condition, as the average of Pavement Condition Index (PCI) is 97. Only certain section of the roads need to be repaired and others only need the routine maintenance to make sure the road to be in a good condition.

References


