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IMPLEMENTATION OF NEW PAVEMENT MANAGEMENT SYSTEM IN MOSUL CITY+

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Abstract

Pavement management system (PMS) is a set of tools that assist decision-maker in finding optimum strategies for maintenance. (PMS) provides a systematic method for selecting maintenance needs and determines priorities and optimal time for repairs by predicting future pavement condition. Status of current (PMS) of Mosul is studied and the evaluation of pavement condition is conducted, the acquired data is prepared and depend in the stage of recommendation to establish a new (PMS) depending on objective evaluation.

المستخلص

يعرف نظام إدارة الطرق (PMS) بأنه مجموعة الوسائل التي تساعد صانع القرار بإيجاد انسب الطرق لأعمال الصيانة. ويعطي (PMS) طريقة نظامية في اختيار الاحتياجات وحساب الأسبقيات لأنسب حالة والتنبؤ لحالة طرق المدينة المستقبلية، سواء على مستوى المشروع أو عموم شبكة طرق المدينة لتوفير القيادة الآمنة والمريحة والاقتصادية على مستوى الفرد والدولة. درس واقع حال مدينة الموصل من حيث إدارة صيانة الطرق وثبتت الملاحظات .أجريت عملية تقييم حالة بعض من طرق المدينة اعتمادا على ما متيسر من إمكانيات مالية وعلمية وملاحظات ومعدات ، نظمت المعلومات المستخلصة في جدول النتائج التي في ضوءها تبين ضرورة وضع نظام إدارة طرق حديث يواكب الركب العالمي ويعتمد الأساس العلمي في التقييم.

Introduction

Pavement management system (PMS) is a set of tools or methods that assist decision maker in finding optimum strategies for providing and maintaining pavements in serviceable condition over a given period of time. The function of a (PMS) is to improve the efficiency of decision making, expand in scope, provide in feedback on the consequences of decisions, facilitatiy the co-ordination of activities within the agency, and insuring the consistency of decisions made at different levels within the same organization [1] .

Shahin (1994) notes that a (PMS) provides: "A systematic, consistent method for selecting maintenance and rehabilitation needs it determines priorities and the optimal time for repair by predicting future pavement condition [2].

PMS is described in term of two generalized levels (a) the network management level, where key administrative decisions on road networks are made, and (b) the project management level where technical management decision are made on specific project [3].

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PMS can provide several benefits for highway agencies. Foremost among these is the selection of cost-effective alternative, where new construction, rehabilitation, or maintenance are concerned, a total PMS can help management to achieve the best possible value for the public funds [3].

Aim and purpose of the study

The aim of this study is to suggest establishment of a new system of pavement management in Mosul City. The basic purpose of pavement management system is to achieve best value possible for the available public funds and to provide safe, comfortable and economic transportation. The function of management at all levels involves comparing alternatives, coordinating activities, making decisions and seeing that they are implemented in an efficient and economical manner.

The current status

The engineers in Mosul municipality face a lot of difficulties when accounting to the government and to the public for allocated funds. In practice, pavement maintenance decisions are based on personal judgement and the experience of individuals which most of the time, relies upon different and inconsistantent source of information. Although engineering judgement is fundamental to decision making, with This kind of uncoordinated approach, cost-effective solutions to pavement problems would be very difficult if not possible to obtain. Consequently, it is evident that pavement decision would be inconsistent. It was recognized at the beginning of the study presented in this paper that proper and effective decision making tools for determining cost-effective pavement maintenance and rehabilitation programs are urgently needed. These will help the decision-makers and engineers not only to select which street sections to repair and when, but also to determine the best way of accomplishing this within resource constraints. In 2002 the funds allocated to Mosul municipality was 120 million dinar, this budget has been spent of the maintenance on main streets and constructing some new streets in a developed, remote areas in Mosul city, see table (1).

Table (1): The allocated budget for Mosul municipality.

Years	Total budget million dinars
2001	330
2002	620
2003	$915ooo(after June) form CPA
2004	850

*Courtesy of Mosul municipality.

Methodology

The first step in the development and implementation of PMS is the establishment of a new system, which depends on the information requirements of the organization. Referencing systems that are commonly used in road management include road or street name, and its municipal number [4].

It is decided to establish a new map for Mosul city depending on a new space image from Landsat, and the detailed ground surveying conducted at municipality with the aid of Mosul Technical Institute, Department of Surveying, this map is shown in Figure (1),

and it is helps in making the inventory of street data such as length, width, decks, pavement section, detailed, drainage features and construction history.

The acquisition of data is one of the most expensive components of PMS in term of time and money [1]. To avoid the problem of excessive data collection, data design was made in such a way that the absolute minimum data necessary to provide the required management information is collected.

Pavement condition evaluation

Pavement condition is a topic of central concern in pavement management because most pavement designers and maintenance personnel must consider pavement condition in their activities; pavement condition involves four main component (a) riding comfort, (b) load carrying capacity, (c) safety, (d) aesthetic. Pavement condition .evaluation provides information to the planning group for assessing deficiencies on a network basis, and to the design group for detailed project analysis. It is also the key part of the PMS and provides the means for assessing needs on both project and network basis. [5],

Type of pavement evaluation

There are many types of pavement evaluations:

A. Pavement roughness. (Performance)
b. Structural capacity
c. Pavement distress
D. Safety (skid resistance).

Roughness:

Roughness is one of the most sensitive values in pavement distress models and maintenance programs [6], there are several methods and types of equipment used for roughness measurement, but no one of them can be used in Mosul city because (a) the equipment is not available in Iraq (b) the absence of training personnel's, For these reasons the evaluation for individual, subjective rating of panel is used .A form used at AASHO road test is used as shown in Figure (2). The results of survey used by this format are shown in table (3).

Structural capacity

Two main groups of test are usually used is nondestructive and destructive. The nondestructive evaluation of the structural capacity is highly desirable and separated into three categories;

- Response to static (or moving) load
- Response to repeated or dynamic load
- Response to controlled source of nuclear radiation.

All these methods of evaluation also can not be used In Mosul city, but the method of taking small core drilling to obtain thickness and sample of underlying material for laboratory testing can be done in Mosul city and basically these will be as non destructive, because no disruption is involved [5]. The results are shown in table [3].

Destructive evaluation:

When the original structure of the complete pavement is destroyed the destructive testing is applied. In general, such evaluation is restricted and it has been used on test roads to determine the evolution of distress [6]. This method involves cutting into each pavement layer and removing sample for testing. This test was carried out on the Al-hadba road, which leads to Telkeaftown; the result is shown in table [3].

Pavement distress measurement:

The available methods currently used for distress measurement range from visual surveys to detailed manual measurements to use of automated systems with little manual interventions. Some users of manual method argue that the methods are subjective, non-repeatable, and unsafe and involve- high personnel costs [7]. It is decided to use the defect rating instead of condition indices, the reason for this decision are two fold, firstly, composite indices lose some information at each level of aggregation, and secondly, it may take several years to develop and validate indices that are specific for Mosul city. Weaver [8] found that if panel ratios are properly devised, conducted and analyzed, they could measure serviceability with adequate precision and reproducibility. New York Department of Transportation has successfully used the work of Weaver. The principles of Weaver to assess pavement condition are subjective, and are used as manual of condition evaluation which identifies various types of pavement distress to assess pavement condition rating (PCR). The manual is based on visual inspection of pavement, which is suited to most roadway and site pavement management system (PMS), and it is quickest and least expensive [9]. PCR can be expressed in mathematical expression to provide an index reflecting the composite effects of varying distress types, severity and extended on the over all condition of pavement .The mathematical expression is as follows:

NPCR= 100-2-f Deduct N> number of observable distress, and
Deduct = (weight for distress) (weight for severity) (weight for extend)
See table (4) &(5)

The condition of pavement depends on the value of PCR as shown in Figure: (3)

Evaluation of safety

There is no practical method developed to directly measure micro texture, commonly used substitute is to measure low speed friction by British pendulum test as specified in ASTM E303. This equipment measures the wet skid resistance in term of skid resistance value (SRV) which corresponds to the skidding value of apparent tire travelling at about 50 k/hr. Apart from its simplicity, the equipment is also cheap and easily portable (10). However, the equipment is very slow in measuring the surface friction of the pavement surface, and does not give a proper representation of the values at speed much higher than 50-km/hr [11]. Usually the minimum skid resistance value required according to ASTM E274 is 37 at 64 k/hr or as shown in table (2). The instrument is available in Iraq.

Table (2) SRV versus speed, note Imile/hr^l^km/hr, source [12].

spe (mph)	10	30	50	70
SR	52	44	34	29

All test results are presented in table (3) to give indication on the condition of streets under test and any row of table gives a manifestation of the selected street, the annual average daily traffic (AADT) is obtained from Unit of Traffic Engineering, municipality of Mosul.

Table (3): summary of pavement evaluation.

Street name	AADT	Roughness •M/km	Surface condition	Structural adequacy	Skid number
1. 1-A1 Arabia	3800	300	good	Adequate	65
2. Al -Balediyyat	4000	50	Good	Adequate	55
3. Al-Muthanna	5200	700	Poor	Inadequate	50
4. Al-Masarif	3900	100	Fair	Critical	60
5. Bab-shames	4100	200	Good	Adequate	65
6. Palestine	4000	30	Good	Adequate	65
7. Al-Naggar	2000	100	Fair	Adequate	65
8. Al-Yermook	5600	900	V.poor	Inadequate	50
9. Al-Jededa	3000	650	Poor	Inadequate	55
10. Be weeza	2900	1000	V.poor	critical	50

Conclusion:

This research is the first step in attempting to establish PMS in Mosul City. It can be replaced in future by rational economic needs- based budgeting approach in which budgets are based on live cycle road cost. Although relationship between pavement distress and performance is not well defined, there is general agreement that the ability of pavement to sustain traffic loads in safe and smooth manner is adversely affected by the occurrence of observable distress. The rating method provides approach for uniformly identifying and describing, in terms of severity the extent pavement distress. -

Recommendation:

It is recommended to establish and implement a PMS at any level (i.e., project level for first trial or short term work program for a five years period .. .etc) with the aid of consutants, specialist engineer and managers under the available constrained budgets and tools. This will enable municipality to improve and goes a long way toward the development of technology. However, as pointed out by Robinson et al (13), optimization over long periods has several shortcomings. In addition to high computational requirements, the main problem is the uncertainty of predicting different parameters into the future. These parameters include:

a) future traffic levels.

b) future unit costs and economic viability of selected treatments.

c) availability of required budget when need For these reason it is recommended to use reduced time period analysis.

Acknowledgement:

The researcher acknowledges the help he received from the staff and engineers of Mosul Municipality in collecting the required data.

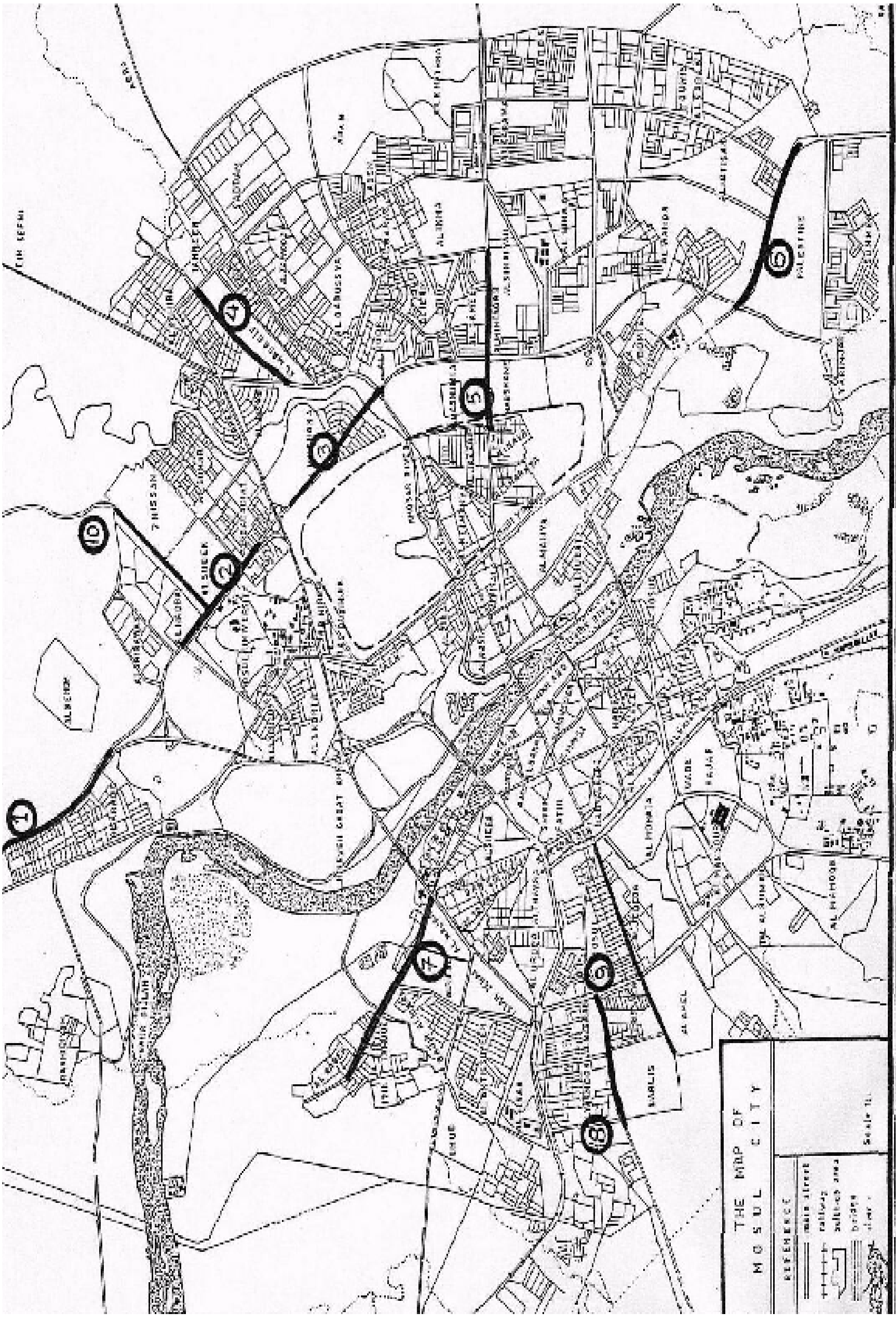
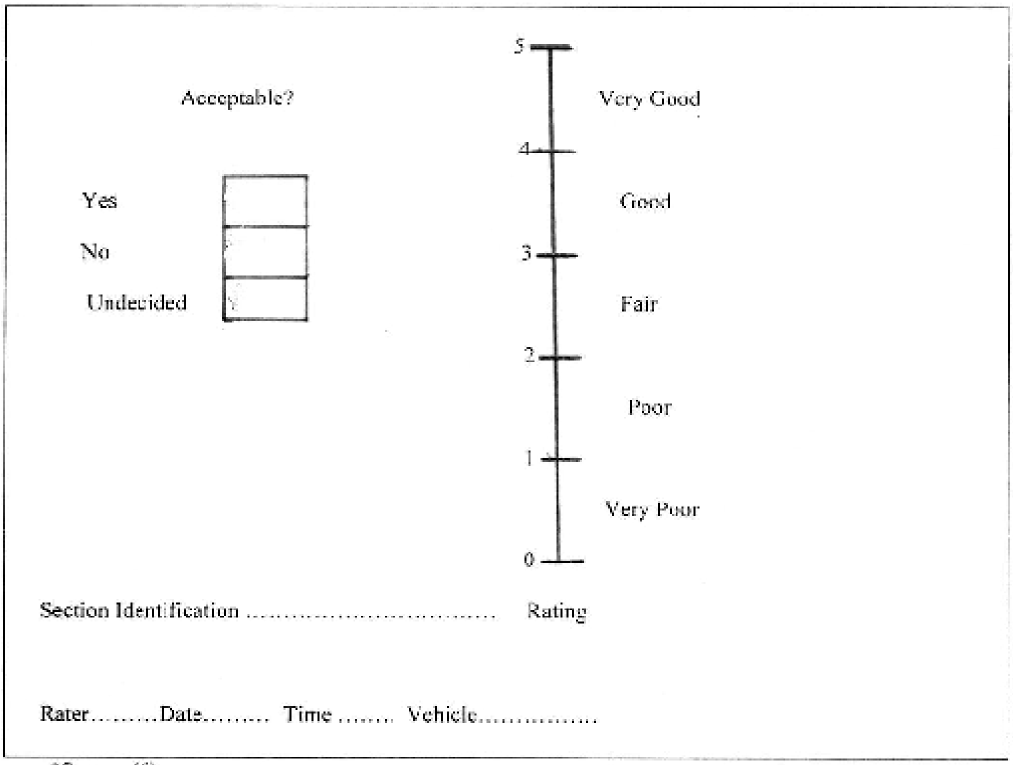


figure (1), Map of Mosul City

Figure (2): Indivdual Present Serviceability Rating Form Used at AASHO Road Test*.



*Source (6).

Figure: (3). **PCR versus Condition of Pavement**

Source (9).

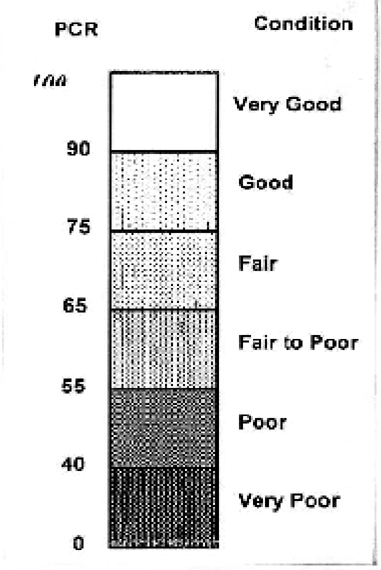


Table (4): SUMMARY OF PCR DEDUCT VALUES*

Distress Type	Distress Weight	Severity L	Severity M	Severity H	Extent O	Extent F	Extent E	Total
Raveling (Flexible/Composite)	10	.3	.6	1	.5	.8	1	____
Bleeding (Flexible/Composite)	5	.8	.8	1	.6	.9	1	____
Corrugations (Flexible)	5	.4	.8	1	.5	.8	1	____
Rutting (Flexible/Composite)	10	.3	.7	1	.6	.8	1	____
Potholes/Debonding (Flex./Comp.)	10	.4	.7	1	.5	.8	1	____
Patching (All Pavement Types)	5	.3	.6	1	.6	.8	1	____
Settlement (All Pavement Types)	10	.5	.7	1	.5	.8	1	____
Crack Seal Deficiency (Flex./Comp.)	5	1	1	1	.5	.8	1	____
Wheel Track Cracking (Flexible)	15	.4	.7	1	.5	.7	1	____
Longitudinal Joint Cracking (Flex.)	5	.4	.7	1	.5	.7	1	____
Longitud. Cracking (Comp./JC/CRC)	5	.2	.6	1	.4	.8	1	____
Edge Cracking (Flexible)	5	.4	.7	1	.5	.7	1	____
Random Cracking (Flexible)	5	.4	.7	1	.5	.7	1	____
Block & Transverse Cracking (Flex.)	10	.4	.7	1	.5	.7	1	____
Transverse Crack (Comp./JC/CRC)	15	.4	.7	1	.5	.8	1	____
Pumping (Comp./JC/CRC)	15	.7	.7	1	.3	.7	1	____
Faulting (Jointed Concrete)	10	.4	.7	1	.5	.8	1	____
Surface Deterioration (JC/CRC)	10	.4	.7	1	.6	.8	1	____
					Total Deduct			____
					100 - Total Deduct = PCR			____

Flex Flexible Pavement
Comp Composite Pavement
JC Jointed Reinforced Concrete or Jointed Concrete Pavement
CRC Continuously Reinforced Concrete Pavement

* Source (9).

Table (5) SUMMARY OF PAVEMENT DISTRESS *

Distress Type	Surface Treatment	Interlayer Membrane
Raveling (Flexible/Composite)	L:O,F,E M:O,F,E	L:O,F,E M:O,F,E H:O
Bleeding (Flexible/Composite)	M:O,F,E H:O,F	M:O,F,E H:O
Corrugations (Flexible)	L:O,F	L:O,F M:O
Rutting (Flexible/Composite)	L:O,F,E M:O	L:O,F,E M:O
Potholes/Debonding (Flex./Comp.)	ALL	L:O,F,E M:O,F,E H:O
Patching (All Pavement Types)	ALL	ALL
Settlement (All Pavement Types)	L:O	L:O,F M:O
Crack Seal Deficiency (Flex./Comp.)	O,F,E	O,F,E
Wheel Track Cracking (Flexible)	L:O,F,E M:O,F	L:O,F,E M:O,F,E H:O
Longitudinal Joint Cracking (Flex.)	L:O,F,E M:O,F	L:O,F,E M:O,F,E H:O
Longitud. Cracking (Comp./JC/CRC)	NA - L:O,F,E M:O,F	ALL
Edge Cracking (Flexible)	ALL	ALL
Random Cracking (Flexible)	ALL	ALL
Block & Transverse Cracking (Flex.)	L:O,F,E M:O,F,E H:O	ALL
Transverse Crack (Comp./JC/CRC)	L:O,F,E M:O,F,E H:O	ALL L&M H:O,F
Pumping (Comp./JC/CRC)	L:O	L:O
Faulting (Jointed Concrete)	L:O M:O	L:O,F M:O,F
Surface Deterioration (JC/CRC)	L:O M:O	All L&M H:O,F

Flex Flexible Pavement
Comp Composite Pavement
JC Jointed Reinforced Concrete or Jointed Concrete Pavement
CRC Continuously Reinforced Concrete Pavement

L = LOW O = OCCASIONAL
M = MEDIUM F = FREQUENT
H = HIGH E = EXTENSIVE

* Source (9).

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