

الجامعة السودانية للعلوم والتكنولوجيا

**Sudan University of Science & Technology**

**College of Graduate Studies & Scientific Research**

**Application of Micro PAVER Program for PMMS of  
Central Sudan Roads**

مؤلف: د. محمد عيسى عبد الله محمد

مؤيد: د. محمد عيسى عبد الله محمد

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**Prepared by:**

**Mohammed Eisa Abdalla Mohamed**

**Supervisor:**

**Professor. Galal Abdalla Ali**

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## ***Dedication***

*I am most grateful to my family, without their love, care and continuous support this thesis would never be finished.*

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## *Abstract*

The study has developed a pavement maintenance management system (PMMS) for roads which have been constructed by the National Highway Authority (NHA) in Sudan. The scope of the MicroPAVER system aims to manage the maintenance activities within the available resources and reduce cost on maintenance works. The system depends mainly on systemic methods and procedures in data acquiring, recording, pavement evaluation, maintenance priorities, maintenance needs and decisions, and determining the cost and activities of the future maintenance programs, using computer software integrated with geographic information system (GIS) program for managing geographic and inventory data. This study involves field survey data for 617 km on the roads in the centre of Sudan. To achieve these goals the pavement maintenance management system (PMMS) contained basic elements organized in the subsequent items:

- Identification and coding system, where the pavement samples were divided into equal sections, then a standardized coding method applied to the road network.
- Inventory of pavement data collection procedure, and use of inspection data survey collection.
- Local pavement evaluation systems investigated, and compared with MicroPAVER system. A visual inspection procedure was used to evaluate the pavement sections under study using standard field surveying practice.
- Database Development Computer software's (MicroPAVER 5.3) was employed for database management. The process includes data storage, manipulation, conversation and retrieving.

- After determination of maintenance needs and decisions based on predefined standards and constraints, a methodology was set to identify treatment required for each pavement section.
- Identification and implementation of maintenance standards for maintenance priorities included all the road sections needs maintenance listed in descending ordered.

It can be stated that at the end of all section, evaluations in 3 sections of total 7, the pavement condition was good; in 2 sections, the pavement needed maintenance and rehabilitation; and finally 2 sections the pavement needed total renewal or reconstruction. It is believed that, most of the distresses observed on the pavement were due to environmental effects 53%; furthermore, load-related causes were 21%; and other reasons 26% according to Micro PAVER method.

The current status of Sudan road network showed an urgent need for an emergency program for pavement maintenance, rehabilitation, and reconstruction. The results of the study for the 617 km sample indicated, in general, that the majority of these roads possessed high pavement distress indices and consequently low pavement condition index (PCI) values, irrespective of the road classification.

A National Agency and Local Highway Agency are recommended to adopt a comprehensive program to keep roadway structures in acceptable conditions. As an initial step, the suggested MicroPAVER for Pavement Maintenance Management System (PMMS) is recommended to be implemented by the National Highway Authority.

## مستخلص

الدراسة تهدف الى تطوير نظم صيانة رصف الطرق للطرق المشيدة من قبل الهيئة القومية للطرق والجسور في السودان . الهدف من تطبيق نظام المايكروبيفر هو إدارة أنشطة الصيانة بالموارد المتاحة وتقليل الفترة الزمنية لأعمال الصيانة ، اذ أن النظام يعتمد على طريقة إجراءات منهجية في جمع البيانات وتسجيلها ومن ثم تقييم الرصف واتخاذ القرار المناسب لأولويات واحتياجات الصيانة مع تحديد تكاليف الأنشطة لبرامج الصيانة المستقبلية بإستخدام نظم الحاسوب لحصر البيانات .

هذه الدراسة تحتوى على بيانات مسح حقلي لـ 617 كم وعينات مأخوذة من طرق المنطقة الوسطى في السودان ، للوصول الى نظم صيانة الرصف من تحديد عناصرها وترتيبها لبنود جزئية كما يلي :-

- تعريف وترميز النظام و تقسيم طبقات الرصف الى عينات و من ثم الى قطاعات مقسمة بالتساوي منتهيا بتطبيق الترميز القياسي لشبكة الطرق .
  - استخدام معلومات الفحص البصري لتقييم لاقطاعات المختلفة للطريق تحت الدراسة.
  - تطوير البيانات و ادارتها بإستخدام برنامج المايكروبيفر 5.3 تم اجراء العمليات المطلوبة لتخزين البيانات و حصرها و استرجاعها مرة اخرى .
  - تحديد احتياجات الصيانة و اتخاذ القرار المناسب على اساس التعريفات القياسية و الطرق المستخدمة لمعالجة قطاعات اجزاء الطريق .
  - تعريف اولويات الصيانة و تنفيذها حسب مواصفات الصيانة و وضع هذه النتائج على شكل قائمة تحتوي جميع اجزاء الطريق مع قائمة احتياجات الصيانة المطلوبة على ضوء ذلك الترتيب .
  - تحديد و تأسيس برنامج الصيانة المستقبلية و تكاليف أنشطة الصيانة و قوائم برنامج الصيانة المختارة و اعتماد الميزانيات.
- و قد نتج من خلال الدراسة والتقييم ان 12 قطاع من مجموع 20 قطاع واحد في حالة جيدة وفي 7 قطاعات طبقات الرصف تحتاج الى الصيانة و اعادة التأهيل ، و قطاع يحتاج الى اعادة تشييد.
- كما وجد ايضا ان 53% من عيوب طبقات الرصف بسبب عوامل المناخ ، و 21% تتعلق بالاحمال و 26% لعوامل اخرى .

تم تحديد م قترح لصيانة هذه الطرق و ادارتها و متابعتها بإستخدام برنامج المايكروبيفر مع تجد يد  
بيانات المسح البصري و دليل حالة الرصف لا طرق و متابعتها كل فترة زمنية حسب  
الاستراتيجيات و بإستخدام نظم المعلومات الجغرافية .

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## **List of Abbreviations**

**PMMS:** Pavement Maintenance Management System

**NHA:** National Highway Authority

**GIS:** Geographic Information System

**PCI:** Pavement Condition Index

**PSR:** Pavement serviceability Rating

**AASHTO:** American Association State of Highway and Transportation Official

**PSI:** Pavement Serviceability Index

**PCR:** Percent Condition Rating

**USA:** United State of America

**ASTM:** American Society for Testing and Materials

**SHRP:** Strategic Highway Research Program

**LTPP:** Long-Term Pavement Performance

**FHWA:** Federal Highway Administration

**SIDA:** Swedish International Development Agency

**USACE ERDC:** US Army Corps of Engineers, Engineer Research and Development Center

**M&R:** Maintenance and Rehabilitation

**EMS:** Engineered Management System

**LCC:** Life cycle cost

**Pct:** Pavement condition sections