

**Final Report  
for  
Iowa Highway Research Board  
Project HR-248**

**EVALUATION OF A MOBILE  
RUT DEPTH DEVICE  
FOR THE  
PAVEMENT MANAGEMENT  
PROGRAM**

**September 1984**

TE  
205  
.M37  
E93  
1984

PROPERTY OF  
Iowa DOT Library

Highway Division



**Iowa Department  
of Transportation**

17-T68HR  
9:M713

Final Report  
for  
Iowa Highway Research Board  
Project HR-248

EVALUATION OF A  
MOBILE RUT DEPTH DEVICE  
FOR THE  
PAVEMENT MANAGEMENT PROGRAM

by

Vernon J. Marks  
Research Engineer  
(515) 239-1447

Office of Materials  
Highway Division  
Iowa Department of Transportation  
Ames, Iowa 50010

September 1984

## TABLE OF CONTENTS

Introduction	1
Problem Statement	1
Objective	2
Benefits of a Mobile Rut Depth Survey	2
Equipment Availability	3
The Mobile Rut Depth Device	3
Evaluation of The Mobile Rut Depth Device	4
Conclusions	5
Recommendations	5
Acknowledgements	5

## INTRODUCTION

With inflation, there is no longer a completely adequate budget for highway construction and maintenance. Restricted budgets have generated development and implementation of pavement management programs. A need for management guidelines generated National Cooperative Highway Research Program Synthesis of Highway Practice 84, "Evaluation Criteria and Priority Setting for State Highway Programs". Traffic volumes and present conditions are two major factors in determining the priority of a proposed highway improvement.

The Iowa DOT, Highway Division, Office of Materials has been conducting pavement condition inventory surveys on a three-year frequency since 1969 as input for pavement management.

Development of substantial wheel rutting on paved roadways results in a potential hazard to highway safety. During periods of rain, these water-filled ruts may cause hydroplaning and loss of vehicle control. It is, therefore, imperative that Iowa roadways be continually monitored for rut depths and further that this data be used in a pavement management program to determine priorities for rehabilitation or resurfacing.

## PROBLEM STATEMENT

In 1981, due to reduced funding and increased project costs, the Iowa DOT initiated a substantial reduction in work force. Pavement condition surveys are more important due to reduced rehabilitation efforts. There are not sufficient funds to upgrade all roadways to the level of quality of past years. Some degree of deterioration will be necessary on roads with lower

traffic volumes. Rut depths have been measured manually from 1969 through 1984. With fewer personnel, it is necessary to adopt methods which will reduce the time and cost of obtaining pavement condition data.

### OBJECTIVE

The objective of this research was to evaluate a mobile, non-contact method for obtaining rut depths and to compare this system to manually obtained data.

### BENEFITS OF A MOBILE RUT DEPTH SURVEY

A mobile rut depth survey would yield a number of very valuable benefits. The first would be improved safety of the data gathering personnel. With the present manual rut depth program, the test personnel must be in the traveled way for a substantial period of time. Even with proper signing, this presents a serious traffic hazard on heavily traveled primary and interstate roadways. The obstruction of the normal flow of traffic by the testing personnel also generates a safety hazard for the traveling public. It increases the potential for accident by the motorist.

Another important consideration is the monetary aspect. Our present manual, "Crack, Patch and Rut Depth Survey", costs \$72.93 per mile. This amounts to approximately \$25,000 per year for the survey. The estimated cost of a mobile rut depth survey would be approximately \$12,500 per year or a savings of approximately \$12,500 per year.

Another consideration would be the reduction in time for a survey of a given program. Data would be more readily available.

## EQUIPMENT AVAILABILITY

This project was initiated on July 13, 1982. In anticipation of the project, a literature search had been conducted in June, 1982. This literature search revealed very limited information on organizations capable of conducting mobile rut depth surveys. The units identified were a segment of a large data gathering test system. They were not available as a separate unit. A number of companies supplying highway testing equipment were contacted in an effort to identify one commercially available rut depth survey device. Only SIE Operation, a division of GEO Source Incorporated, noted that they would supply such a device.

## THE MOBILE RUT DEPTH DEVICE

The SIE mobile rut depth device was a 12-foot bumper-mounted sensor bar with a cathode-ray tube readout and, a cassette recorder. The bumper-mounted sensor bar included a rigid 6-foot center portion with a foldout 2-foot extension on each end. The resulting 10-foot long, bumper-mounted sensor bar included 11 sonar-type distance sensors at 1-foot intervals. The cathode-ray tube was to display the longitudinal roadway location along with the readings of all 11 distance sensors at that location. The cassette recorder produced a magnetic tape to be read by a Texas Instrument Silent 700 computer.

The mobile non-contact rut depth device was designed and constructed by SIE at their plant at Fort Worth, Texas. The rut depth device was mounted on the front bumper brackets of a 1982 Volkswagon Rabbit pickup. The Iowa Department of Transportation delivered the Volkswagon pickup to Fort Worth, Texas, for installation of the rut depth device on December 16, 1982.

## EVALUATION OF THE MOBILE RUT DEPTH DEVICE

Upon return to the Iowa Department of Transportation facilities, a laboratory evaluation of the rut depth device was conducted. The cathode-ray tube did not display accurate measurements for a few of the distance sensors. An interchange of sensors did not correct the problem. This indicated that the problem was in the electronic reduction of the signal from the sensor unit. A technical representative of the SIE Company visited Iowa and corrected the electronic problems.

Field trials of the device were then conducted at highway speeds. The device would properly display the rut depth measurements on the cathode-ray tube. The 11 measurement readings and the longitudinal location were displayed on the cathode-ray tube until the next set of readings was obtained. Only one set of measurements was retained on the cathode-ray tube at a time.

The magnetic tapes obtained by the rut depth device could only be read by a Texas Instrument Silent 700 computer. The Iowa Department of Transportation did not have any of these units, but did locate one for limited use during the project. An analysis of one of the magnetic tapes revealed that no data from the rut depth device had been recorded. The recording system was repaired by SIE personnel and functioned properly for a short period of time. The recorder again malfunctioned and failed to retain data on the magnetic tape. The data reduction system was returned to the SIE Company at Fort Worth, Texas, for repair. Due to other higher priority functions, the SIE Company has not been able to deliver an operating unit to the Iowa Department of Transportation. Evaluation of the rut depth device at various speeds on roadways with varying depths of rut has not been conducted due to the inability to record the data.

## CONCLUSIONS

The very limited evaluation of the mobile rut depth device supports the following conclusions:

1. The device exhibited a potential for collection of data at highway speeds.
2. The device did not function in a satisfactory condition to collect data for a rut depth survey.
3. Further evaluation is necessary before the device could be accepted for use by the Iowa Department of Transportation.

## RECOMMENDATIONS

It is recommended that the Iowa Department of Transportation continue to pursue purchase and use of a commercially-available, mobile, non-contact rut depth device.

## ACKNOWLEDGEMENTS

Appreciation is extended to Steve Linder and the SIE Operation Company for their efforts and expense in development of the mobile rut depth device. The evaluation of the rut depth device was conducted by Charles Potter, Lyman Moothart, Karman Kellogg and Special Investigation personnel. Research project HR-248 was supported by the Iowa Highway Research Board and the Iowa Department of Transportation with available funding of \$11,000.