HIGH-SPEED ROAD PROFILE EQUIPMENT EVALUATION

by

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SUMMARY REPORT 73-1(S)

SUMMARY OF
RESEARCH REPORT 73-1 PROJECT 3-8-63-73
COOPERATIVE HIGHWAY RESEARCH PROGRAM
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SUMMARY REPORT

Foreword

This short report summarizes the first report in a series of reports which will be written covering the feasibility of measuring road profiles at high speed. The basic report of which this is a summary defines the problems and discusses preliminary considerations. It also evaluates the capabilities of available equipment. Future reports will summarize all phases of this research project.

Introduction

Design speeds for highways have increased steadily since the development of the automobile. The high design speeds used for modern highways demands that long flowing ribbons of pavement be maintained in a very smooth condition in order that the traveling public will be served adequately.

Evaluation of the relative smoothness of pavements has in the past been largely a matter of qualitative judgment, but now there is a recognized need for developing equipment which is capable of providing a quantitative measure of pavement smoothness. Such equipment is badly needed in the pavement evaluation studies which are now being conducted in Texas and which are expected to continue for the next several years.

Equipment for measuring pavement roughness which has been developed up to now limits the accuracy with which the true road profile can be measured and the speed with which measurements can be made. In general, the slower equipment gives greater accuracy; however, there exists a need for a new device capable of measuring road roughness more accurately and more rapidly than now possible. Particular attention should be given to long-wave-length roughness (25 feet plus) as these characteristics are not presently being evaluated satisfactorily.

Equipment

The only existing profilometer which appears capable of measuring true profile accurately is the device developed by the General Motors Proving Grounds (Ref. 5). The device is small, compact, and relatively inexpensive. The road wheel is mounted on a trailing arm underneath the measuring vehicle. The wheel is held in contact with the ground with a 300 lb. spring force. The truck mass and truck suspension form a mechanical filter between the road and the accelerometer. The relative motion of a location on the vehicle body and the road wheel is measured with a potentiometer. The accelerometer is mounted on the vehicle body above the road following wheel at a point where the potentiometer fastens to the body. Figure 1 shows a sketch of these components. The signal from the accelerometer and the potentiometer are input into an analogue computer which is carried in the vehicle. This computer integrates the acceleration signal twice and sums the resulting vertical motions to obtain true profile. The term "true profile" is a slight misnomer since wave lengths longer than about 200 feet are attenuated toward zero in proportion to their amplitude. Thus, it would be better to say that the device gives a good indication of true profile for wave lengths shorter than about 200 feet and produces a signal proportional to true profile for longer wave lengths.

In spite of these apparent shortcomings, the GMR profilometer has shown to be a very effective tool for measuring road roughness. Its main drawback is its output, which is an analogue record of the pavement surface. The use of such a device for, say, four hours per day at fifty miles an hour could result in 200 miles of profile per day or the equivalent of 1000 road miles of profile per work week. It is uneconomical and almost humanly impossible to read such quantities of data with hand methods. It seems essential that electronic data processing be coupled with this device to produce a digital output.

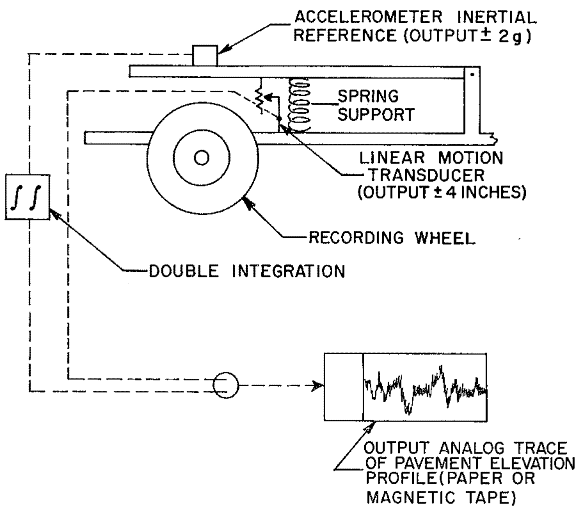

FIGURE 1

Schematic Sketch of GM Profiler

Summary and Recommendations

Consideration of all available data at the present time indicates that the GMR profiler is the best profilometer which will be available to highway engineers for at least five years. It is high-speed, far more accurate than other equipment available and is compact and efficient in operation. With the addition of proper digital data processing equipment the GMR device can serve not only as a basic tool for evaluating roadway profile parameters and their relationship to riding quality and ultimately to specifications for finished roadway surfaces, but also can serve as a summary profiler for evaluating serviceability (PSI) for pavements as desired by District Engineers and designers throughout the State of Texas. This could include particularly the evaluation of the growing mileage of continuously reinforced pavements as well as any experimental pavements which are constructed. Such a device would greatly facilitate the continued observation of the sections selected for the Texas road test study.

In summary, it is recommended that:

(1) This project be extended for one additional year and that funds be budgeted for immediate purchase of a GMR Road Profilometer with compatible digital data processing equipment.

(2) This equipment be evaluated and put to use as soon as possible by the Research Section of the Texas Highway Department in any way in which they desire.

(3) Project personnel should evaluate the prototype device developed by Lane-Wells Corporation if and when it becomes available and include in the final report of the project the results of said evaluation.

(4) Every effort should be made to proceed with evaluation of the gyro-stabilized device at no cost to the Texas Highway Department, in order that this information might be available for future studies and further developments.

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