R-489

PROGRESS REPORT
ON EVALUATION AND APPLICATION STUDY OF GENERAL MOTORS CORPORATION RAPID TRAVEL PROFILOMETER

A Michigan State Highway Department Research Project
In Cooperation with the Bureau of Public Roads
and the General Motors Research Laboratories
of the General Motors Technical Center

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John C. Mackie, Commissioner
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Introduction

The principal purpose of this project, as set forth in the proposal, is to evaluate a new, rapid travel, pavement and bridge surface measuring device, and determine its applicability to the purposes of the Michigan State Highway Department. The following brief progress report outlines accomplishments to date, problems encountered, and recommended solutions to these problems.

Progress

All electrical and mechanical profilometer parts have been purchased and assembled in the vehicle to complete the system as originally planned. The system is now operative and numerous field tests have been performed on pavements of various surface quality classifications. As a result of these field tests, the following changes and/or additions to the system are necessary, in order to make it practical for routine highway testing:

1. It was found that the power supply presently used in the system is not adequate to handle all the power requirements of the tape recorder,

monitor box, and other accessories. As a result overload or near overload conditions exist when the system is in operation. This overloading is evidenced by a 60-cycle noise pulse superimposed on the magnetic tape signal records. This pulse decreases the signal-to-noise ratio to a point that often renders the recorded data useless for derivation of a road profile. This problem can be solved by replacing the present power supply with one of higher power capacity. The present power supply can be retained in the system for use as an auxiliary supply for the oscilloscope, voltmeter, etc.

2. Conversion of field-recorded acceleration and displacement data to road profile, via analog computer, requires a high amplification of the accelerometer signal. Consequently, noise pulses on the magnetic tape, from any source, may destroy the validity of the computed profile. It has been found that the tape erase heads on the recorder can not adequately reduce the tape's noise level before use, and therefore, a thorough degaussing will be necessary before any recording is attempted. This will require procurement of a device for degaussing bulk recording tape.

3. General Motors has built and tested an analog computer designed for integration into the Rapid Travel Profilometer. This unit is incorporated into the existing monitor box and shares the use of some components in the box. With this system modification the profile is recorded on tape directly, or when necessary or desired, the raw data can be

recorded for later conversion to profile on the laboratory-based analog computer. The principal advantage of this system is that the finished profile can be stored on the tape along with velocity, voice, and photocell signals. Also, since displacement and acceleration signals are not recorded prior to profile conversion, the previously mentioned effects of noise will not interfere with the recorded profile. The components of this unit are readily available stock items, and it can be constructed by Research Laboratory personnel.

4. A mechanical problem encountered during field testing involved structural failure of the potentiometer shaft connected to the follower wheel assembly, caused by the follower wheel's snagging on the pavement edge as the vehicle moved onto the pavement from the shoulder at the start of a test. To prevent this, it was decided that the follower wheel would have to be lowered after the vehicle had entered the traffic lane and raised again before pulling off onto the shoulder. To facilitate this procedure, a spring centering device with positive stops on each end will have to be added to the follower wheel assembly. General Motors personnel have designed and submitted a device to us to accomplish this. Also, since the follower wheel will now be raised and lowered while the vehicle is in motion, it will be necessary to replace the hand-operated pump with an electrical pump so the driver's attention will not be distracted while performing this operation.

5. Because the quality of the recorded signals will not be known until they are played back in the laboratory, it was decided to add an oscilloscope as a permanent part of the complete system for the purpose of monitoring the incoming signals. This will eliminate the possibility of collecting a large amount of erroneous data.

6. Instrumentation recorders of the magnetic tape type cannot and will not operate at their optimum level in an environment contaminated by dust, high humidity, vehicle exhaust fumes, etc. To overcome this environment, common to pavement and bridge testing, a vehicle air conditioner is required. Such a unit, used in conjunction with the vehicle heater, will make it possible to operate in all seasons with a completely enclosed vehicle containing a clear, conditioned atmosphere.

Figure 1. View of Rapid Travel Profilometer vehicle showing pavement follower arm in test position (potentiometer shaft not connected).

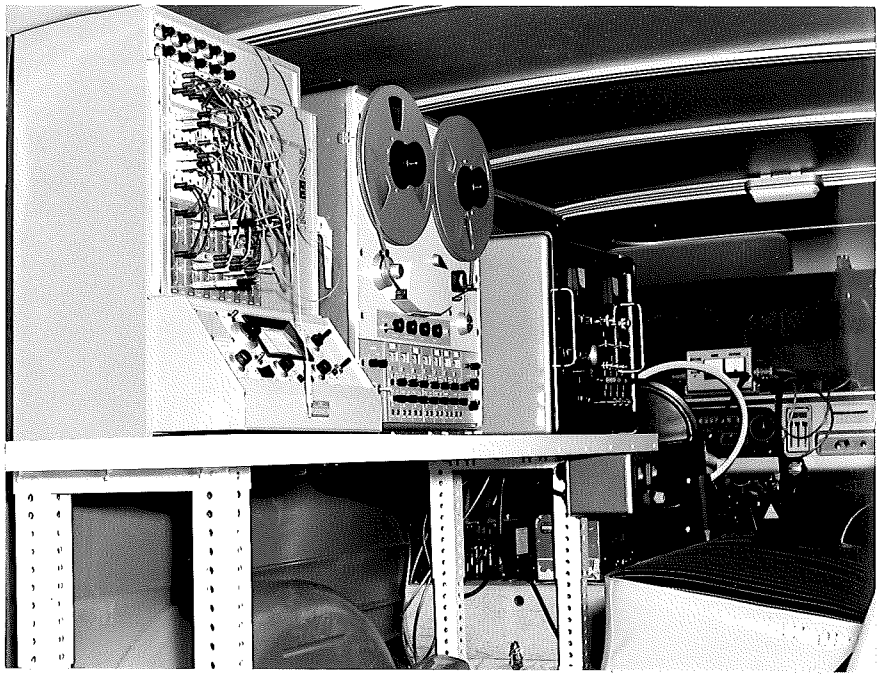

Figure 2. View of interior of profilometer vehicle showing, from left to right, the anagog computer, magnetic tape recorder, and monitor box. Also shown is the system power supply on floor under far end of table, and driver's speed control equipment mounted on dash above speedometer.