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PROGRESS REPORT ON STUDY OF DYNAMIC LOAD ASPECTS OF TRUCK SIZE AND WEIGHT

Prepared for Cooperating Agencies

Michigan State Highway Department
Automobile Manufacturers Association
Truck-Trailer Manufacturers Association
Michigan Trucking Association

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PROGRESS REPORT ON STUDY OF DYNAMIC LOAD ASPECTS OF TRUCK SIZE AND WEIGHT

This report summarizes the progress made on the cooperative investigation of dynamic load aspects of truck size and weight by the Michigan State Highway Department and the Automobile Manufacturers Association, with the cooperation of the Michigan Trucking Association and the Truck-Trailer Manufacturers Association. It covers, in addition, some instrumentation improvements and new equipment obtained by the Highway Research Laboratory necessary to expedite certain research objectives of this study. Information concerning future work is included.

The project has been divided into five individual studies. Progress made on each study will be treated separately.

Study No. 1 - Vehicle Design

The purpose of this study is to gather design information on various types of commercial vehicles as a guide in selecting the test vehicles for use in conjunction with the other phases of the project.

Only sufficient progress has been made in this study to permit selection of vehicles used in completed field tests which will be mentioned under Study No. 2 and 3.

Study No. 2 - Measurement of the Relative Effects Caused by Different Types of Commercial Vehicles on Pavement Surfaces

Field tests completed under Study No. 2 are described as follows:

Field Test No. 1 - Load-deflection tests on concrete pavement - US-27 North of Lansing, Nov. 20, 1956.

Field Test No. 2 - Load-deflection tests on concrete pavement - US-27, M-78 Southwest of Lansing, June 20-21, 1957 and load-deflection tests on flexible pavement - M-79 West of Charlotte, June 20-21, 1957.

Field Test No. 3 - Load-deflection and load-stress tests on concrete pavement - US-27, M-78 Northeast of Charlotte, July 31, Aug. 1, 1957.

Data from all three tests have been analyzed and interpretations made in terms of the relative effect of different types of commercial vehicles. Detailed analysis included construction of load-deflection curves and influence lines for single and tandem axles. These data have been applied to a broad range of typical commercial vehicles to determine their relative effect on concrete pavement. The material is now in shape to proceed with the preparation of a formal report on this phase of the work.

In connection with the tests on flexible pavement, instrumentation difficulties due to the compaction of the bituminous material alongside the pavement deflectometers caused erratic deflection readings and, consequently, the bituminous phase of the program requires further testing in order to obtain reliable deflection data.

Study No. 3 - Determination of Axle Load Fluctuations Under Various Speeds and Pavement Conditions

Five field tests have been conducted under Study No. 3 for the purpose of determining the best method of instrumentation to measure dynamic axle load change. These tests are as follows:

Field Test No. 4 - Dynamic runs with the GMPG pilot truck and with both vehicle and pavement instrumented - US-27 and M-78 Northeast of Charlotte, Aug. 21-22, 1957.

Field Test No. 5 - Simulated impact by drop testing of instrumented rear axle on GMPG pilot truck with pavement instrumented - US-127 between Leslie and Jackson, Nov. 7, 1957.

Field Test No. 5A - Drop tests with instrumented MSHD weight truck at Research Laboratory, Dec. 24, 1957.

Field Test No. 6 - Drop tests with instrumented MSHD weight truck on GMPG electronic scale at General Motors Proving Ground, April 23, 1958.

Field Test No. 6A - Dynamic runs with instrumented MSHD weight truck for comparing results of strain gages and pressure cells, April 28, 1958.

Tests No. 4 and 5 were conducted jointly by the General Motors Proving Ground and the Michigan State Highway Department in order to determine whether strain gages or tire air pressure transducers gave the most accurate information on axle load variation under dynamic conditions. Analysis of the data on Test No. 4 proved too complicated and erratic and, therefore, Test No. 5 was conducted to remedy this.

Although in Test No. 5 neither strain gage nor air pressure transducer instrumentation indicated axle load change in perfect correlation with pavement deflection and strains, the strain gage instrumentation data appeared to be much more reasonable. However, it was concluded that the air pressure transducers were not functioning properly for some unexplainable reason. Therefore, Tests No. 5A, 6 and 6A were conducted in order to obtain additional data on the air pressure transducers. Better data resulted from these latter tests and these data indicate that the tire air pressure transducers would be the best way of instrumenting the truck axles for obtaining the magnitude of the dynamic axle load changes on various pavement surfaces.

The Department has taken steps in two ways to improve its research facilities for carrying out the dynamic axle load study. First, a 7 ft. by 11 ft. electronic scale will be completed this year at the Fowlerville Weighing Station which will be available exclusively for calibration of instrumentation and for other phases of this joint investigation. Second, new electronic instrumentation for the Department's roughometer has been obtained. With this equipment, it is possible to separate the acceleration levels of the roughometer frame into five groups. The accumulation of the numerical count of acceleration into these five separate levels will give

a much more accurate picture of the roughness condition of the pavement and a better index of riding quality. This new equipment should also be useful as an adjunct to the dynamic axle load study for correlation between roughness and magnitude of dynamic axle load variations.

Study No. 4 - Weight Distributions Between the Various Axles on the Vehicle Under Static and Dynamic Conditions

No work has been done on this study. Progress is dependent on the availability of data from Study No. 3.

Study No. 5 - A Study of Commercial Vehicle Design in Relation to the Roadway

This study is dependent on the results obtained from Studies No. 2, 3, and 4.

Objectives for 1959

1. Complete a report on Study No. 2 pertaining, in particular, to the effect of different types of commercial vehicles on concrete pavement.

2. Conduct field tests to determine the effect of different types of commercial vehicles on a flexible pavement, and prepare a report.

3. With the background of preliminary data obtained in Field Tests No. 4, 5, 5A, 6, and 6A, it is now possible to start a full scale program to determine dynamic axle load variations at various speeds for different types of commercial vehicles on pavements of varying roughness. It is planned to start this work in the Spring of 1959.

4. It is intended to continue accumulating design data on commercial vehicles as planned under Study No. 1.

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