CHAPTER 6
RESULTS OF THE EXPERIMENT ON VEHICLES-ACCELERATION MEASUREMENT ON POSITIVE AND NEGATIVE GRADES (TB-3)

The purpose of experiment TB-3 is to study the way vehicle speed varies on positive and negative grades during the acceleration phase to regain the steady-state speed.

For this experiment two hypotheses were initially considered. The first consisted of stopping a certain number of vehicles of different classes at the beginning of a previously selected positive grade, and observing them by means of radar while they accelerated to return to their normal traffic speed. The second consisted of simulating this situation with the PICR test fleet, and measuring acceleration by means of instruments installed in the vehicles.

The first hypothesis, although more realistic, presented a number of logistical problems which made it impracticable; so it was decided to carry out the experiment with the test fleet.

The use of the second hypothesis made it possible to observe, simultaneously with acceleration, fuel consumption during the acceleration phase (see experiment FCS-4).

In order to eliminate the influence of driver behaviour and make the results obtained comparable, the drivers were instructed to use maximum acceleration to reach the steady-state speeds proper to their vehicles on that specific positive grade. Although necessary for making the results comparable, this procedure constituted a restriction on the experiment in the case of cars, because the results may reflect a somewhat exaggerated acceleration as compared to normal driving. In the case of trucks, the influence of maximum acceleration seems insignificant, since truck drivers tend to adopt this behaviour due to the low acceleration power of freight vehicles.

The analysis of variance shows that the significant factors in the determination of speed increments are the distance run by the vehicle, the type of vehicle, the load, the grade, and the roughness of the riding surface (Swait, 5/9/79 and 5/23/79).

Tables 6.1 and 6.2 present, for each class of vehicle and type of surfacing, the equations of speed change as a function of the distance run by the vehicle during the acceleration phase, as well as of the interaction of this factor with all other significant factors

TABLE 6.1 - EQUATIONS OF SPEED INCREMENTS (PAVED SURFACE)

Car	$\Delta V = \{0.04444+0.00016x(PW-46.1)-0.00238xG-0.000038xQI\}xD$
Bus	$\Delta V = \{0.03903+0.00037x(PW-17.1)-0.00109xG-0.000038xQI\}xD$
Utility	$\Delta V = \{0.04894+0.00037x(PW-38.1)-0.00109xG-0.000038xQI\}xD$
Light Gasoline Truck	$\Delta V = \{0.04538+0.00037x(PW-46.5)-0.00109xG-0.000038xQI\}xD$
Light Diesel Truck	$\Delta V = \{0.03903+0.00022x(PW-28.2)-0.00109xG-0.000038xQI\}xD$
Heavy Truck	$\Delta V = \{0.03737+0.00037x(PW-11.1)-0.00109xG-0.000038xQI\}xD$
Semi-Trailer	$\Delta V = \{0.03903+0.00037x(PW-9.6)-0.00109xG-0.000038xQI\}xD$

TABLE 6.2 - EQUATIONS OF SPEED INCREMENTS (UNPAVED SURFACE)

Car	$\Delta V = \{0.05639+0.00021x(PW-46-1)-0.00169xG-0.000046xQI\}xD$
Bus	$\Delta V = \{0.03811+0.00021x(PW-17.1)-0.00131xG\}xD$
Utility	$\Delta V = \{0.04735+0.00021x(PW-38.1)-0.00245xG-0.000025xQI\}xD$
Light Gasoline Truck	$\Delta V = \{0.04152+0.00021x(PW-46.5)-0.00131xG\}xD$
Light Diesel Truck	$\Delta V = \{0.03325+0.00021x(PW-28.2)-0.00131xG\}xD$
Heavy Truck	$\Delta V = \{0.03951+0.00021x(PW-11.1)-0.00131xG\}xD$
Semi-Trailer	$\Delta V = \{0.03325+0.00021x(PW-9.6)-0.00131xG\}xD$

Mean Square Error = 1.998 $(m/s)^2$

Coefficient of Determination = 0.895

Number of Observations = 3445

ΔV = speed increment (m/s)

D = distance run during acceleration (m)

G = grade (%)

QI = roughness index

PW = power/weight ratio (HP/t)

mentioned in the previous paragraph.

Figure 6.1 shows the change in speed as a function of the distance run. The vehicle observed was a heavy truck (power/weight ratio of 14.9 hp/t and 7.3 hp/t, corresponding to the vehicle empty and loaded, respectively), on a paved road (30 QI roughness) on a level section, and on a slope with a grade of 6%, running in both traffic directions.

The determination of steady-state speed on positive and negative grades was worked out with the equations obtained from the Experiments TB-1 and TB-2, respectively, whose results are shown in Figure 6.1 to illustrate vehicle speed behaviour on the different grades.

HEAVY TRUCK
EMPTY - AW = 14.9 HP/t
LOADED - PW = 7.3 HP/t
TYPE OF SURFACING = ASPHALTIC
ROUGHNESS = 30 QI

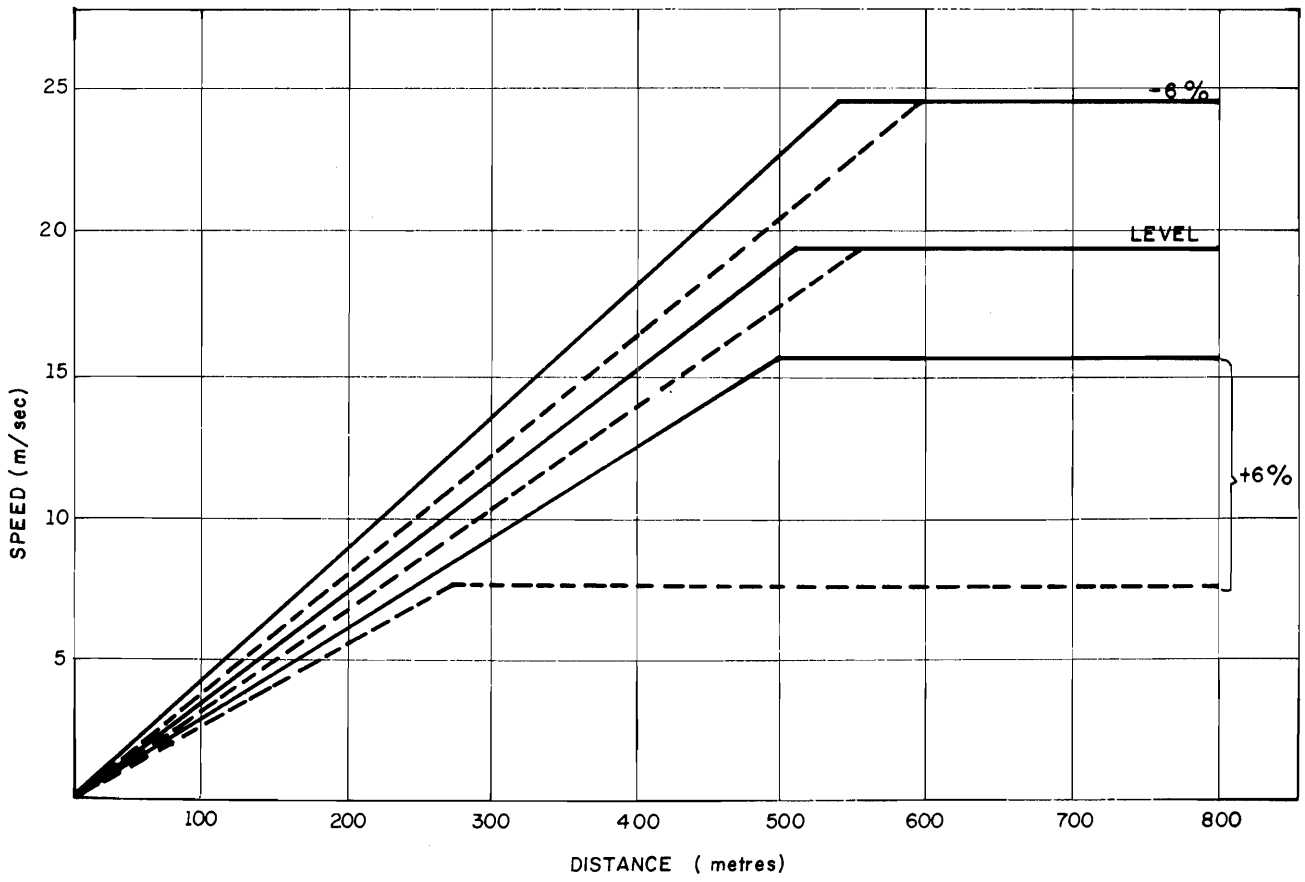

FIGURE 6.1 - CHANGE IN SPEED AS A FUNCTION OF DISTANCE RUN BY VEHICLE