

TRAFFIC SPEED REPORT NO. 73
TRUCK WEIGHT-SPEED STUDY

NOVEMBER, 1961

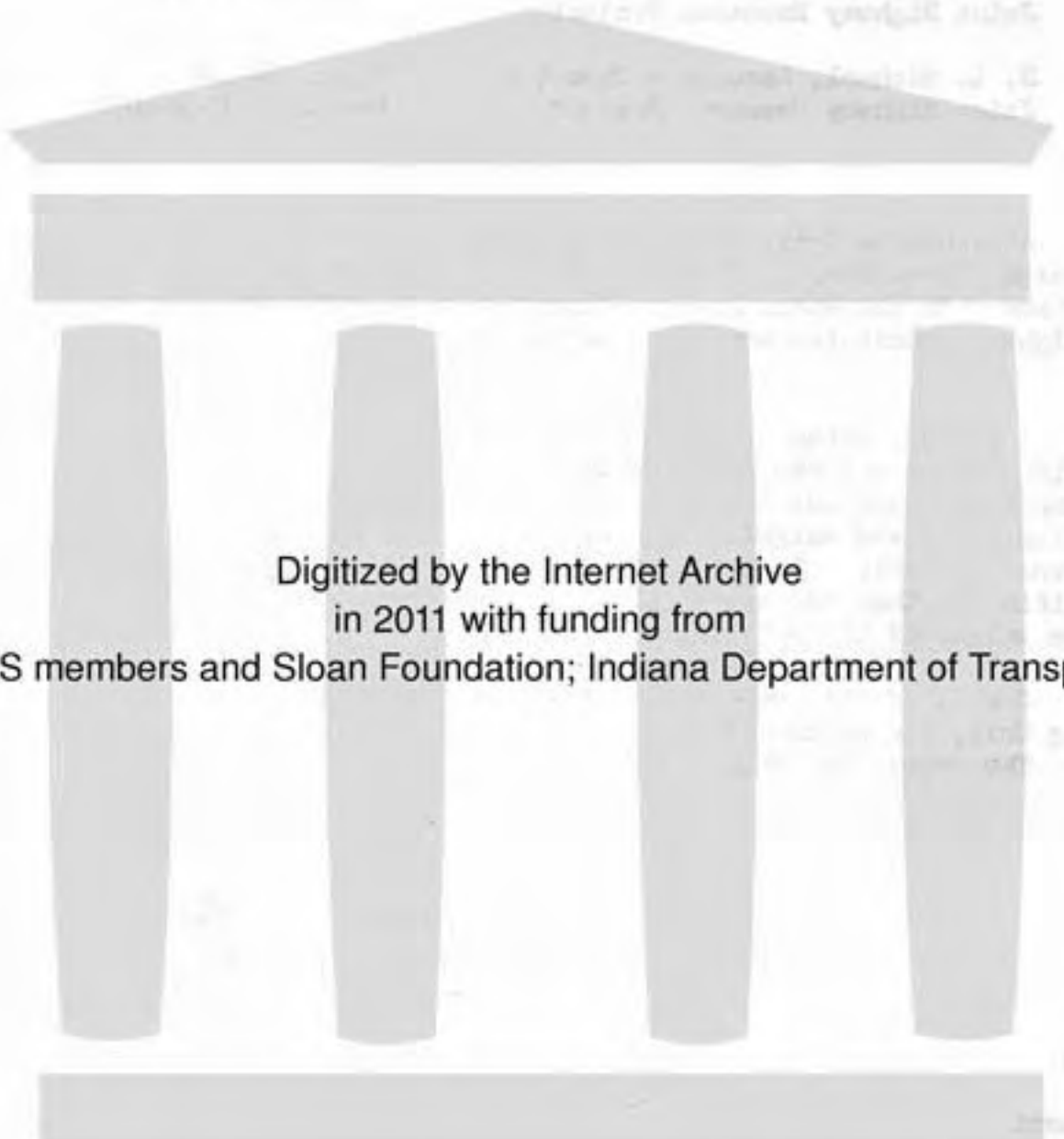
NO. 27

Joint
Highway
Research
Project

by
K. J. THARP

PURDUE UNIVERSITY
LAFAYETTE INDIANA

TRAFFIC SPEED REPORT
BY THE INDIANA STATE DEPARTMENT OF TRANSPORTATION
1900



Station	Time	Speed	Remarks
101	10:00	10	...
102	10:05	10	...
103	10:10	10	...
104	10:15	10	...
105	10:20	10	...
106	10:25	10	...
107	10:30	10	...
108	10:35	10	...
109	10:40	10	...
110	10:45	10	...
111	10:50	10	...
112	10:55	10	...
113	11:00	10	...
114	11:05	10	...
115	11:10	10	...
116	11:15	10	...
117	11:20	10	...
118	11:25	10	...
119	11:30	10	...
120	11:35	10	...
121	11:40	10	...
122	11:45	10	...
123	11:50	10	...
124	11:55	10	...
125	12:00	10	...
126	12:05	10	...
127	12:10	10	...
128	12:15	10	...
129	12:20	10	...
130	12:25	10	...
131	12:30	10	...
132	12:35	10	...
133	12:40	10	...
134	12:45	10	...
135	12:50	10	...
136	12:55	10	...
137	13:00	10	...
138	13:05	10	...
139	13:10	10	...
140	13:15	10	...
141	13:20	10	...
142	13:25	10	...
143	13:30	10	...
144	13:35	10	...
145	13:40	10	...
146	13:45	10	...
147	13:50	10	...
148	13:55	10	...
149	14:00	10	...
150	14:05	10	...
151	14:10	10	...
152	14:15	10	...
153	14:20	10	...
154	14:25	10	...
155	14:30	10	...
156	14:35	10	...
157	14:40	10	...
158	14:45	10	...
159	14:50	10	...
160	14:55	10	...
161	15:00	10	...
162	15:05	10	...
163	15:10	10	...
164	15:15	10	...
165	15:20	10	...
166	15:25	10	...
167	15:30	10	...
168	15:35	10	...
169	15:40	10	...
170	15:45	10	...
171	15:50	10	...
172	15:55	10	...
173	16:00	10	...
174	16:05	10	...
175	16:10	10	...
176	16:15	10	...
177	16:20	10	...
178	16:25	10	...
179	16:30	10	...
180	16:35	10	...
181	16:40	10	...
182	16:45	10	...
183	16:50	10	...
184	16:55	10	...
185	17:00	10	...
186	17:05	10	...
187	17:10	10	...
188	17:15	10	...
189	17:20	10	...
190	17:25	10	...
191	17:30	10	...
192	17:35	10	...
193	17:40	10	...
194	17:45	10	...
195	17:50	10	...
196	17:55	10	...
197	18:00	10	...
198	18:05	10	...
199	18:10	10	...
200	18:15	10	...

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TRUCK WEIGHT-SPEED STUDY

by

K. J. Tharp

Joint Highway Research Project

File No: 8-3-4

Project No: C-36-10D

Performed in Cooperation

with

The State Highway Planning Survey

Indiana State Highway Commission

August 3, 9, 10, 11, 14, 21, 22, 23, 25, 1961

Purdue University
Lafayette, Indiana

November 8, 1961

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TRUCK WEIGHT - SPEED STUDY

Introduction

The seventeenth annual truck weight-speed study was conducted during the month of August 1961 by the Joint Highway Research Project of Purdue University in cooperation with the Highway Planning Survey Unit of the Indiana State Highway Commission. The Highway Planning Survey Unit makes annual studies of truck weights, size, material hauled, etc. at twenty permanent truck-weight stations located throughout the state. The truck-weight speed study matches the weight of a truck, obtained by the Planning Unit with portable loadometer scales, and the observed speed of the same vehicle as recorded at a nearby speed station. This provides the basis for a correlation of truck speeds with truck weights.

Data from nine truck weight stations were used for the truck weight-speed study. These stations are shown on Figure 1 and are further described as follows:

Station	Highway	Location	Date of Obs.	No. of Lanes
45B	S. R. 67	1 mi. S.W. of Muncie	Aug. 3	2
5	U. S. 30	1.3 mi. E. of Bourbon	Aug. 9	2
4	U. S. 31	0.2 mi. S. of U.S. 6	Aug. 10	2
2	U. S. 20	0.3 mi. W. of S. R. 2	Aug. 11	4
14	U. S. 41	0.5 mi. S. of S. R. 2	Aug. 14	4
42	U. S. 52	0.1 mi. S. of S. R. 28	Aug. 21	4
58B	U. S. 31	0.2 mi. S. of Southport Rd.	Aug. 22	4
75	U. S. 41	0.2 mi. S. of U.S. 41 Business Route	Aug. 23	4
81	U. S. 150	0.5 mi. E. of S. R. 56	Aug. 25	2

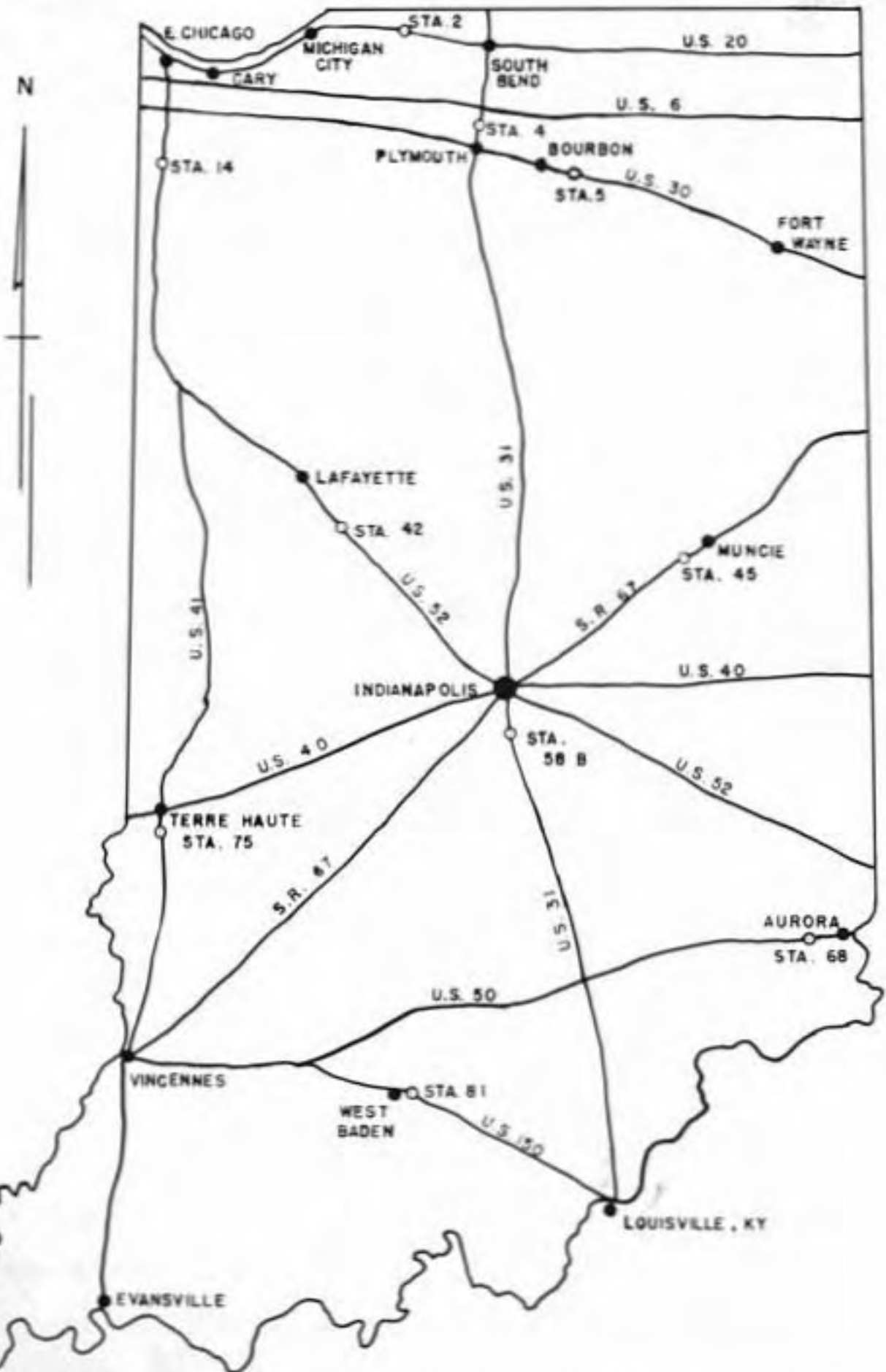


FIG. 1 LOCATIONS OF TRUCK WEIGHT - SPEED STATIONS

The speed observations were made on level, tangent sections of road between one and three miles from the weight station. In all cases, sufficient distance was allowed for the trucks to regain normal cruising speed while minimizing opportunities for the vehicles to turn off the highway.

The speed data was collected by the writer and Mr. Preston Clayton. The analysis was prepared by the writer with the aid of members of the Traffic Engineering Laboratory staff.

Equipment and Field Procedure

The speed observations were made with an ELECTROMATIC Radar Speed Meter reading directly in miles per hour. The radar unit was checked for accuracy prior to field use. Figure 2 shows the adjustments required to correct the radar readings to true speeds. All observations have been revised so that true speeds are presented in this report. While in the field, uniformity of radar readings was verified by frequent checks with a 60-mile per hour tuning fork. At one station, the radar reading was also checked by comparing with a standardized car speedometer.

The radar unit was placed upon a box approximately four feet from the edge of the pavement and was oriented at a small angle with the direction of traffic flow. Concealment of the equipment is not possible upon modern highways having adequate shoulder width. To lessen the effect of driver observation of the speed meter, a car was parked so that on-coming traffic could not see the radar unit in sufficient time to reduce speed. Further deception was accomplished by feigning mechanical malfunction of the car by raising the hood. There was no apparent change in speed as traffic approached the speed station.

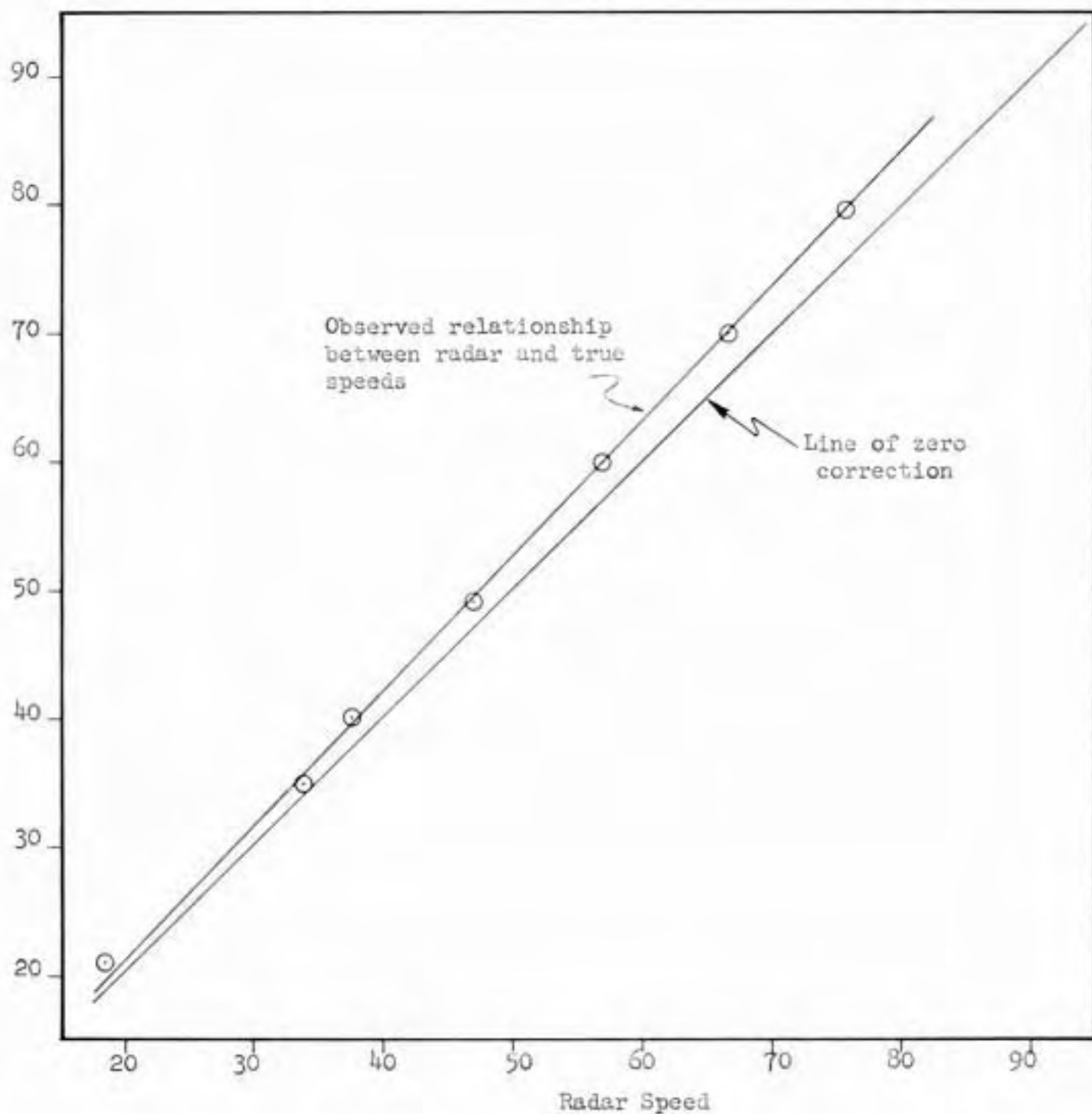


FIGURE 2. CALIBRATION CHART FOR THE ELECTROMATIC RADAR-SPEED METER

For use in this study only ^{normal} highway truck speeds were desired. Therefore, observations were made only on "free-flowing" trucks - that is, not hampered by other traffic or by a change in speed resulting from a turn or stop. This limitation caused a considerable reduction in data on low capacity highways.

The speed stations were operated during the same hours as the truck weight station. During the four-hour period 8 a.m. to 12 noon, trucks moving in one direction along the highway were observed. During the afternoon, 12 noon to 4 p.m., observations were made on trucks traveling in the opposite direction.

Procedure of Analysis

For this analysis all trucks are grouped into the general categories of single-unit or multi-unit (semi-trailer) vehicles.

In addition, the single-unit grouping is subdivided by weight into those having a gross weight of 5,000 pounds or more, and those weighing less than 5,000 pounds. This weight classification corresponds to the existing Indiana speed limits for trucks: 65 miles per hour for "light" (less than 5,000 pounds) trucks; 55 miles per hour for "heavy" (5,000 pounds or more) trucks on four-lane highways with a median of 20 foot or more; and 50 miles per hour for heavy trucks on other highways.

Table I provides the speed and weight data of single-unit trucks while Table II presents similar data for multi-unit trucks. In these two tables, the data are also summarized by type of highway (2 or 4 lane), truck weight and totals for each.

TABLE 17. TRUCK-TRAILER TRUCK (TTT) (1974)

Vehicle	Two-lane Highways								Four-lane Highways								Total Two-lane and Four-lane									
	30		35		40		Total Two-lane		45		50		55		Total Four-lane											
	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks										
10-15	--	--	36.1	2			36.1	2								36.1	2									
15-20	--	--	42.0	1	44.8	1	45.9	2			33.1	2			33.1	3	30.8	4								
20-25	33.6	4	42.0	1	44.2	2		42.7	3	45.2	2	30.8	4	33.1	4	30.8	5	30.2	19	30.0	28					
25-30	30.2	7	46.8	10	44.9	10	40.8	1	47.3	30	43.1	11	30.5	18	31.8	15	31.3	11	31.7	12	30.8	67	43.0	99		
30-35	40.6	18	46.4	13	47.1	10	48.1	16	48.0	55	48.8	20	31.8	33	31.6	29	42.2	26	30.1	13	30.8	183	43.8	178		
35-40	30.8	17	47.0	19	46.8	20	48.2	8	47.8	32	46.2	14	30.0	21	30.7	10	43.8	11	43.7	14	37.2	68	48.8	183		
40-45	30.6	9	45.8	17	46.1	10	43.9	1	46.7	32	43.7	9	32.4	14	30.3	15	31.4	8	31.7	5	30.8	51	43.0	88		
45-50	33.4	8	44.7	5			49.0	4	43.9	17	43.5	3	32.8	15	33.2	9	34.8	7	42.0	3	33.8	37	33.1	34		
50-55	47.8	3	44.0	20	44.7	1	34.1	2	46.2	16	42.2	10	33.6	12	32.8	17	30.1	12	43.0	1	31.4	32	30.1	70		
55-60	48.4	6	42.0	10	43.0	4	30.0	1	46.7	21	30.2	3	32.7	10	31.1	1	42.0	9	47.0	4	36.0	21	42.8	30		
60-65	30.2	4	40.4	12	44.9	1	44.9	2	46.3	20	40.2	11	33.8	14	30.8	9	47.0	11	33.4	3	42.7	46	42.8	66		
65-70	47.2	9	48.8	15	43.0	4	42.4	3	47.2	11	42.8	12	32.4	28	30.8	6	47.2	10	46.8	5	48.8	64	42.3	95		
70-75	43.4	9	46.3	14	45.7	2	47.0	3	47.3	14	47.3	12	32.3	21	31.5	11	44.1	8	43.4	6	30.0	36	43.0	89		
75-80	31.8	2	43.1	14	46.8	2	44.4	4	46.0	14	30.2	3	32.4	4	31.4	3	42.1	6	42.5	4	30.0	20	42.4	30		
80-85	48.3	6	47.2	13			47.0	21	46.8	9	31.4	7	30.0	1	31.4	3	42.4	2	30.0	2	30.0	20	43.0	43		
85-90	30.0	2	42.4	9	44.7	3	43.2	1	47.1	14	43.2	7	30.8	4	40.4	3	47.4	3			47.4	10	47.3	34		
90-95	42.8	4	44.3	8	42.0	4	42.0	1	46.7	15	42.8	13	30.0	3	44.2	3	43.4	2	31.4	2	42.8	23	42.8	38		
95-100	48.0	1	42.3	6	33.4	4	44.9	2	46.2	15	47.7	4	30.1	1	30.4	2			42.3	8	44.0	23				
100-105	--	--	47.2	8			47.2	8			32.2	1	31.5	2	32.4	1			32.2	4	42.2	10				
105-110	--	--	43.2	1			43.2	1																		
110-115	--	--																								
115-120	--	--																								
120-125	--	--																								
125-130	--	--																								
130-135	--	--																								
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170-175	--	--																								
175-180	--	--																								
180-185	--	--																								
185-190	--	--																								
190-195	--	--																								
195-200	--	--																								
Total Trucks	112		189		76		49		425		150		212		130		128		78		704		1,448			
Ave. Speed	41,928		48,268		40,700		40,540		44,281		40,268		41,240		40,273		40,201		37,002		41,863		40,333			
Ave. Speed	47.8		42.3		43.7		40.7		47.2		42.7		31.6		31.6		42.2		42.8		30.1		42.8			
Conf. Int.	954		954		954		954		954		954		954		954		954		954		954		954			
Conf. Int.	30.7		47.1		47.0		47.0		47.3		46.7		34.2		34.1		30.3		43.1		30.3		42.3			
Conf. Int.	42.9		43.7		44.4		43.8		47.1		42.1		30.7		30.7		42.2		41.7		42.7		42.2			
A Ratio	31.2		30.3		31.5		30.8		29.1		28.8		30.8		30.4		30.4		31.3		31.3		31.3			

Summary of Results

From Tables I and II the following observations are made:

Single-unit trucks less than 5,000 lbs.—

	2-lane hwy.	4-lane hwy.	all hwy.
No. of vehicles observed	87	116	203
Average speed (mph)	48.4	50.5	49.6
Average weight (lbs.)	4380	4227	4293

Single-unit trucks over 5,000 lbs.—

No. of vehicles observed	343	392	735
Average speed (mph)	46.4	48.7	47.6
Average weight (lbs.)	12,196	12,422	12,316

Multiple-units (semi-trailers) —

No. of vehicles observed	425	724	1,149
Average speed (mph)	47.3	50.1	48.6
Average weights (lbs.)	44,283	41,605	42,595

Table III reveals that 2% of the light trucks exceeded the legal 65 mph speed limit and only 1% exceeded the "enforceable" speed limit of 70 mph. On two lane highways, slightly over 23% of heavy trucks and semi-trailers exceeded the legal speed limit of 50 mph. The percentage exceeding the enforceable speed limit (55 mph) was 8½% for heavy single-units and nearly 5% for semis. On four-lane highways, approximately 17% of the heavy trucks and 19½% of the semis exceeded the legal 55 mph speed limit. On this type of highway only 5½% of the heavy trucks and 2½% of the semis traveled faster than the 60 mph "enforceable" speed.

A comparison of average speeds and weights for the last 14 years is presented in Table IV. The average speed of single-unit trucks has shown a tendency to increase since 1948. During the last

TABLE III
PERCENT OF TRUCKS VIOLATING SPEED LIMITS

Station	Trucks Weighing Under 5000 lbs			Trucks Weighing Over 5000 lbs			Multiple Units		
	No. Noted	% Exceed 65 MPH	% Exceeding 70 MPH	No. Noted	% Exceeding 50 MPH	% Exceeding 55 MPH	No. Noted	% Exceeding 50 MPH	% Exceeding 55 MPH
45-B	18	0	0	94	33.0	16.0	112	44.6	13.4
5	8	0	0	66	24.2	10.6	188	16.0	1.1
4	31	0	0	106	17	5.7	76	15.8	2.6
81	30	0	0	77	19.5	1.3	49	16.3	2.0
	87	0	0	343	23.3	8.5	425	23.5	4.7
					% Exceeding 55 MPH	% Exceeding 60 MPH		% Exceeding 55 MPH	% Exceeding 60 MPH
2	12	16.6	8.3	48	14.6	8.3	150	11.3	0.7
14	11	0	0	69	21.7	7.2	212	26.0	4.7
42	19	5.3	5.3	75	22.7	8.0	150	12	1.3
50-B	15	0	0	98	13.3	3.1	136	14.7	0.7
75	59	1.7	0	102	15.7	2.0	76	14.5	1.3
	116	3.4	1.7	392	17.3	5.4	624	29.4	2.4
Summary	203	2.0	1.0	735			1149		

Two-lane Highways

Four-lane Highways

TABLE IV
TRUCK WEIGHT-SPEED DATA
COMPARISON OF DATA FROM STUDIES IN VARIOUS YEARS

Year	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
Number of Single-Unit Trucks	493	578	791	1,212	1,482	1,239	905	762	952	1,028	837	481	424	938
Average Speed of Single-Unit Trucks	42.4	42.2	42.4	43.0	43.4	43.9	45.8	45.9	47.0	46.3	46.5	45.5	49.1	48.0
Average Weight of Single-Unit Trucks	8,800	9,400	8,700	8,600	8,700	8,400	8,000	8,900	8,300	9,400	9,900	9,230	12,000	10,600
Number of Multiple-Unit Trucks	627	581	879	1,402	1,354	1,507	1,064	1,120	1,033	1,161	1,130	604	644	1,149
Average Speed of Multi-Unit Trucks	42.7	43.2	42.7	43.5	44.1	43.1	43.6	43.5	44.4	42.5	46.1	48.6	50.3	48.6
Average Weight of Multi-Unit Trucks	31,900	32,500	36,700	36,700	35,900	35,800	37,400	38,400	37,900	37,100	39,500	40,300	39,300	42,595

five years, the average weights have also apparently increased from less than 9,000 lbs. to above 10,000 lbs. The average speed and weight of multi-unit trucks have also increased considerably during this period of time. Semi-trailer weights appear to have a fairly constant upward trend. Figures 8 and 9 portray graphically the apparent upward trend in the 85th percentile speed.

The cumulative frequency distribution curves indicate that multi-unit trucks travel with less speed variation between trucks than the single-unit vehicles. This is disclosed by the steepness of the central portion of the frequency curve and the narrower speed differential between the 15th and 85th percentile. The group exhibiting the greatest variability in speeds is the light single-unit trucks.

A plot of average truck speed versus truck weights produced the diagrams of Figures 6 and 7. The points plotted are average speeds for a weight classification while the lines are derived from individual speeds as observed in the field. For single-unit trucks on both two- and four-lane highways, the slope of the plotted line is significantly different from zero, thus indicating that the speeds vary somewhat with the vehicle weight. The slope of the line for multi-unit vehicles is not significantly different from zero thereby indicating no evidence of a relationship between truck weight and truck speed for this group.

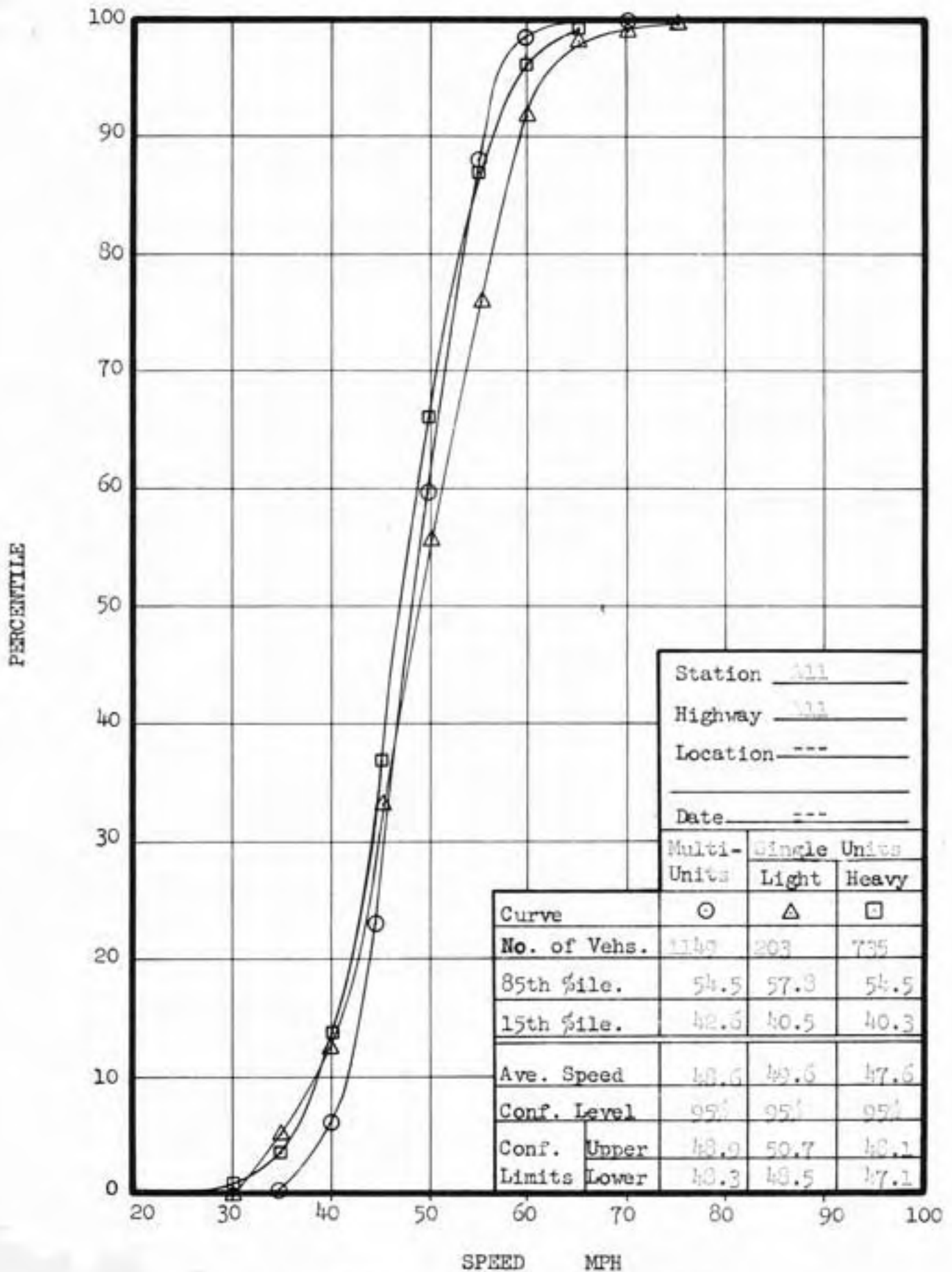


FIGURE 3. CUMULATIVE FREQUENCY CURVES FOR ALL HIGHWAYS

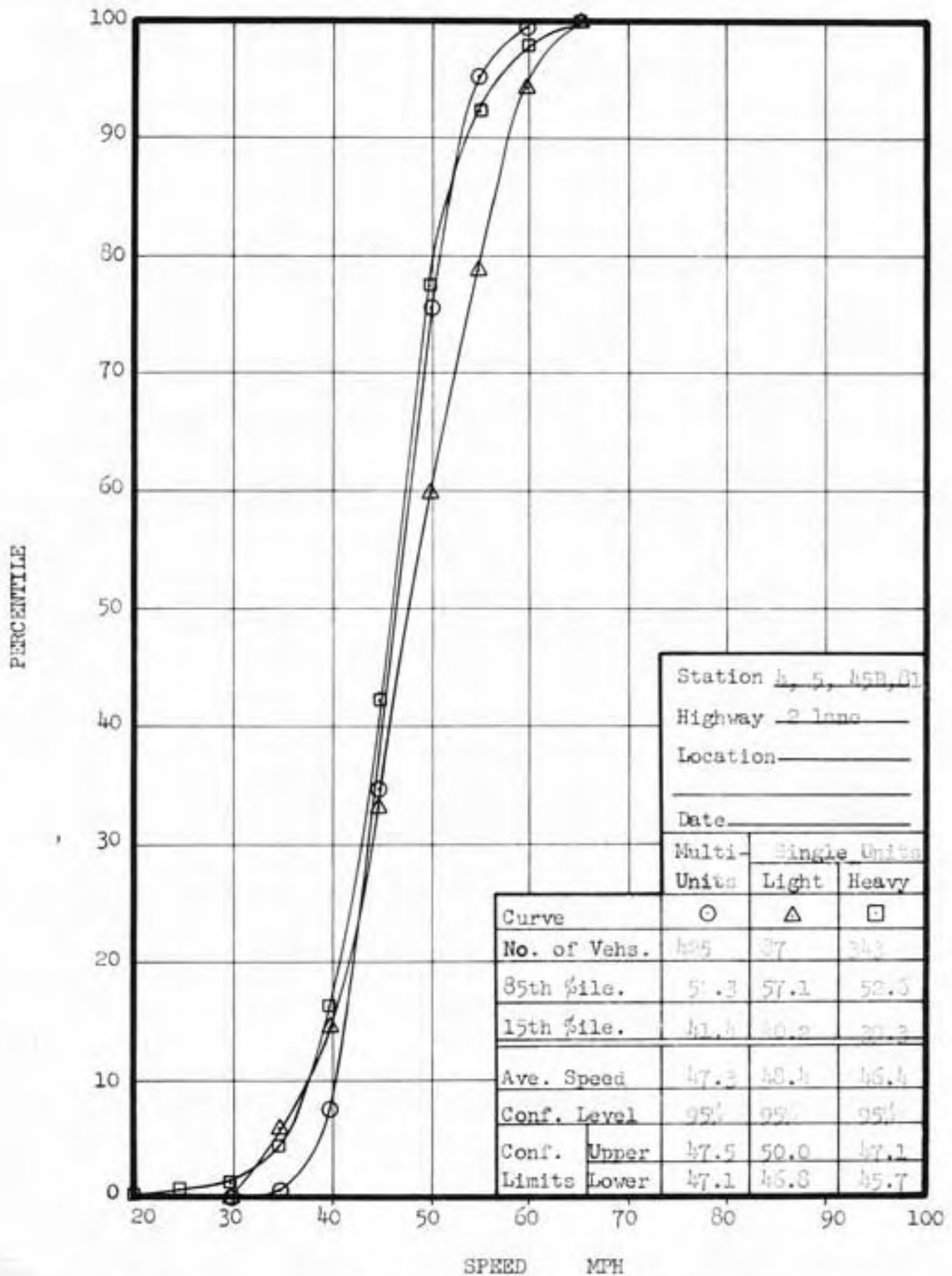


FIGURE 4. CUMULATIVE FREQUENCY CURVES FOR TWO-LANE HIGHWAYS

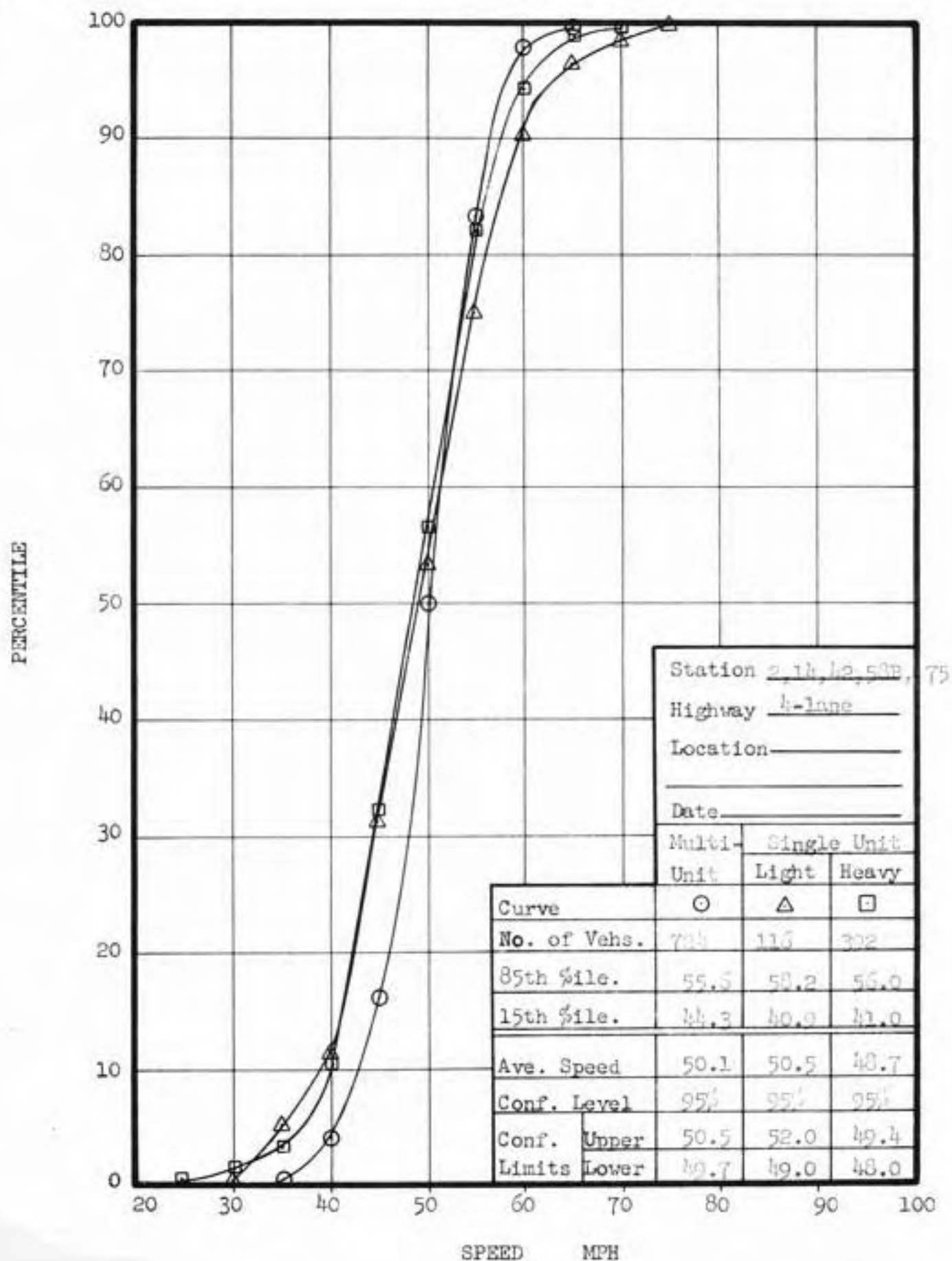


FIGURE 5. CUMULATIVE FREQUENCY CURVES
FOR FOUR-LANE HIGHWAYS

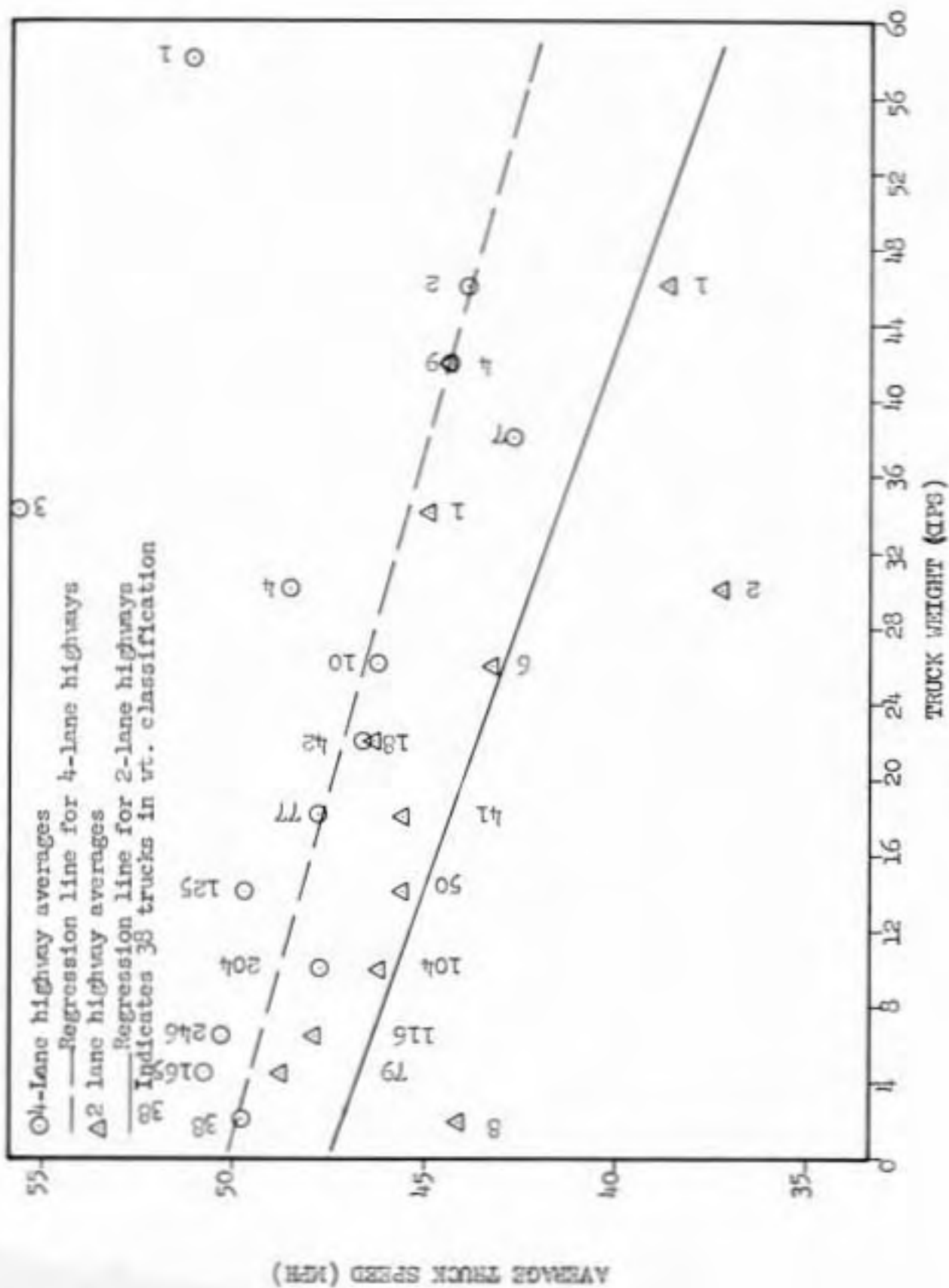


FIGURE 6. AVERAGE TRUCK SPEED FOR TRUCK WEIGHT CLASSIFICATION (SINGLES-UNITS)

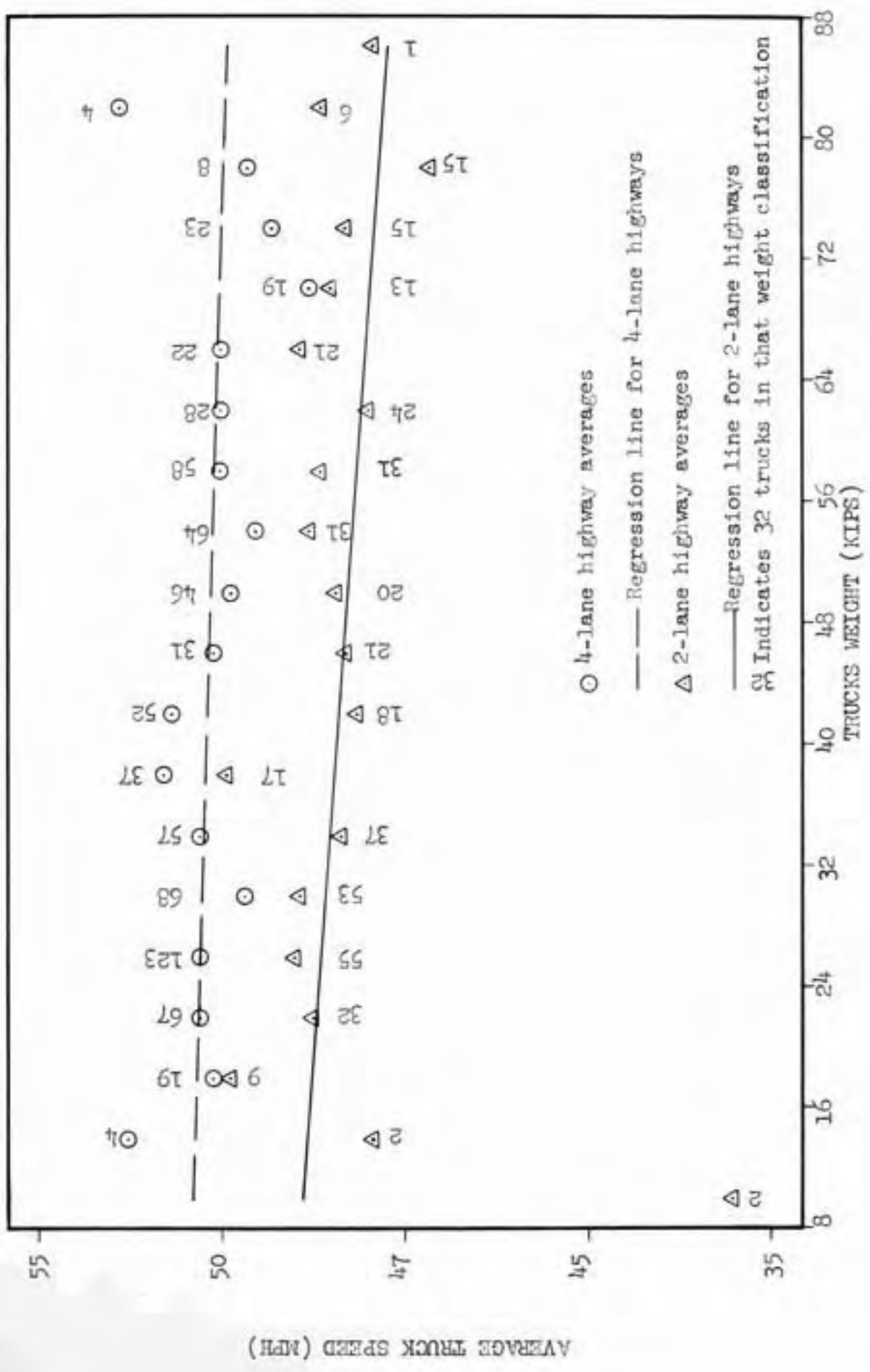


FIGURE 7. AVERAGE TRUCK SPEED FOR TRUCK WEIGHT CLASSIFICATION (MULTI-UNITS)

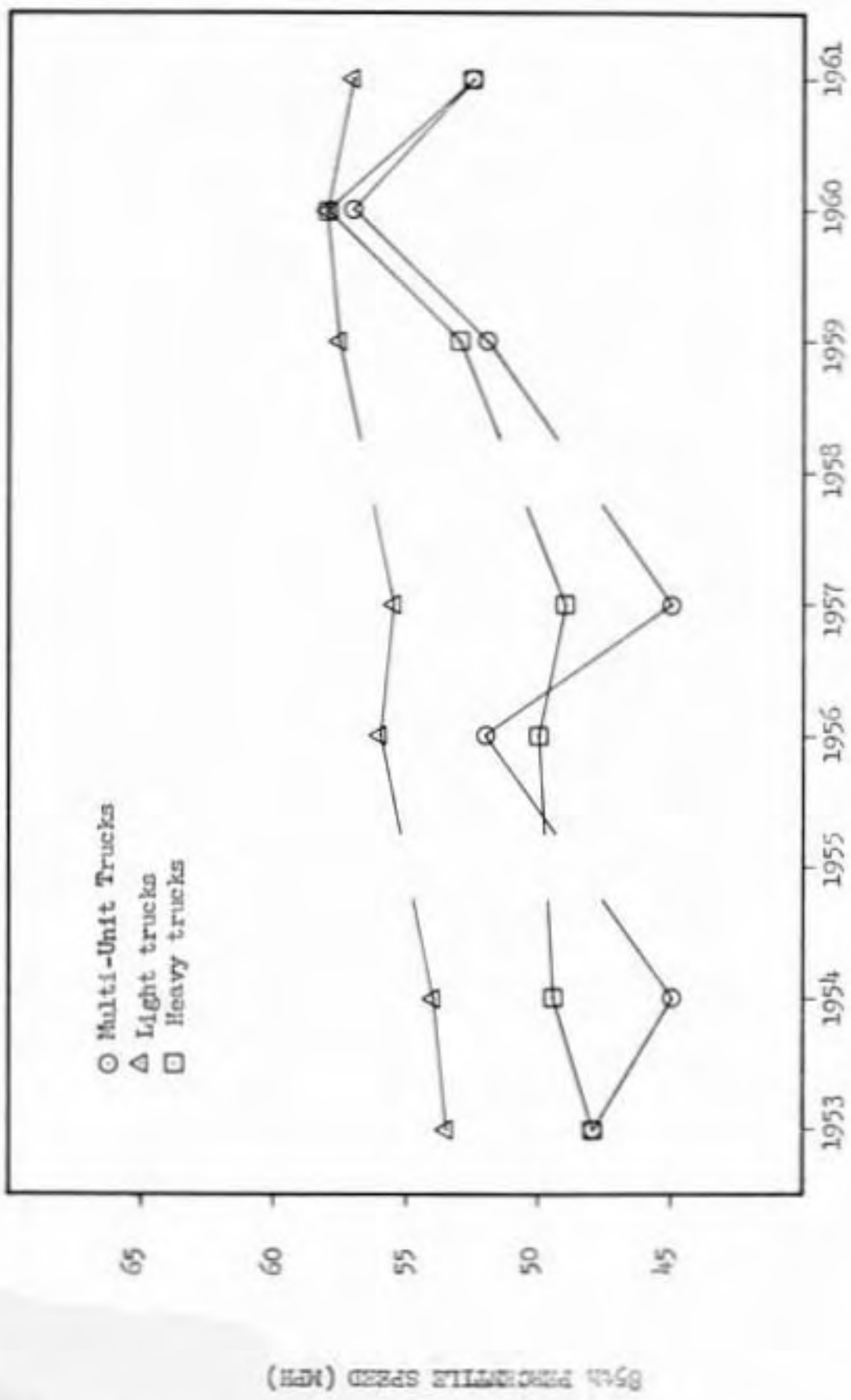


FIGURE 8. TRENDS IN THE 85th PERCENTILE TRUCK SPEED ON TWO-LANE HIGHWAYS (1953-1961)

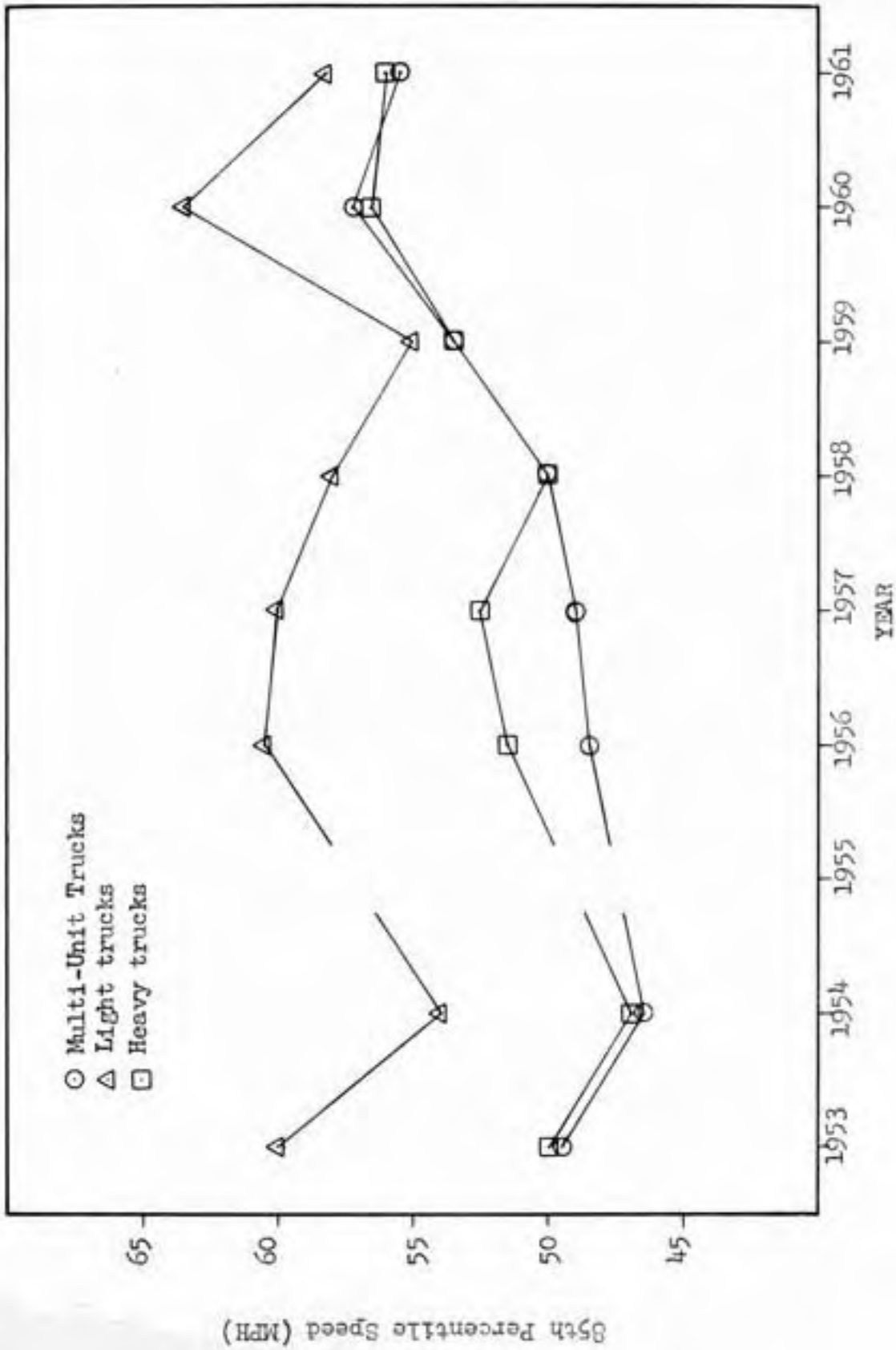


FIGURE 9. TREND IN THE 85th PERCENTILE TRUCK SPEED ON FOUR-LANE HIGHWAYS (1953-1961)