MASTER TRAFFIC COUNT ON U. S. HIGHWAY 65, NEAR AMES, IOWA

By Mark Morris

Research Assistant, Iowa State Highway Commission

SYNOPSIS

This report presents a record of continuous observations of the flow of traffic past a single station for a period of one year, revealing influences of the hour of the day, the day of the week, the week of the month, and the month of the year, upon the volume and composition of the traffic stream

It demonstrates the derivation of traffic flow characteristics from daily traffic patterns, describes the seasonal variations, and applies these characteristics in the computation and co-ordination of actual observations obtained in a statewide survey on the Primary Road System in Iowa during the period from December 1, 1934 to March 31, 1935

The paper also deals with the statistical characteristics of the traffic flow and presents comparisons of the results obtained for the average annual week-day volume of traffic resulting from data taken for counts for various periods of time, varying from one hour to an entire year in length

The principal objective of the Iowa Master Station Traffic Survey was the determination of those characteristics in the flow of traffic on the Primary Road System which would be of value in the preparation of plans for a statewide traffic survey The immediate purposes of the survey were to obtain a continuous hourly record of the traffic flow for a period of one year; to observe at intervals the characteristics of the traffic flow as affected by the hour of the day, the day of the week, the week of the month, the month of the year, and weather and roadway conditions, and to derive from these data traffic flow characteristic factors for use in the analyses of the observations which were to be made at other stations on the Primary Road System for short periods during the operation of this master station

With these objectives in mind, considerable attention was given to the selection of a site for the survey station It was finally located on Primary Road No U S 65 and U S 69, near the south city limits of Ames It was believed that the flow of traffic at this point would be typical of traffic generally on the Primary Road System Experience with the use of the data obtained has indicated that the site was well chosen

DATA TO BE RECORDED

The data recorded were those readily obtained by observation of the traffic stream. Four general classifications were used, cars, trucks, buses, and miscellaneous traffic Provision was made for the sub-classification of each group when necessary. For example, cars with trailers were noted, trucks were kept in three sub-groups: light, medium, and heavy, buses, if used for school children, were so designated, and special contributions to the miscellaneous groups were

TABLE I

SUMMARY OF TOTAL TRAFFIC PASSING STATION FOR YEAR PERIOD BEGINNING NOVEMBER 2, 1934, AND ENDING OCTOBER 31, 1935

Month and Year	Direction of Traffic Flow	Number of Vehicles Passing Station							
		Cars	Trucks				Busses	Misc	Total Traffic
			Class 1	Class 2	Class 3	Total			
Nov , 1934	North	36,746	1,086	2,837	4,196	8,119	339	81	45,285
	South	37,620	1,078	2,658	4,793	8,529	341	78	46,568
	Total	74,366	2,164	5,495	8,989	16,648	680	159	91,853
Dec , 1934	North	26,464	884	2,366	3,847	7,097	414	97	34,072
	South	27,187	780	2,513	3,740	7,033	409	93	34,722
	Total	53,651	1,664	4,879	7,587	14,130	823	190	68,794
Jan , 1935	North	23,056	740	2,596	3,901	7,237	421	76	30,790
	South	22,824	720	2,505	3,972	7,197	379	74	30,474
	Total	45,880	1,460	5,101	7,873	14,434	800	150	61,264
Feb , 1935	North	31,212	895	3,199	4,007	8,101	367	109	39,789
	South	31,343	877	3,064	4,158	8,099	336	91	39,869
	Total	62,555	1,772	6,263	8,165	16,200	703	200	79,658
March, 1935	North	38,875	1,168	4,068	5,232	10,468	399	164	49,906
	South	38,571	1,086	4,030	5,749	10,865	369	146	49,951
	Total	77,446	2,254	8,098	10,981	21,333	768	310	99,857
April, 1935	North	40,456	1,185	3,855	5,035	10,075	382	150	51,063
	South	39,845	1,156	3,665	5,431	10,252	345	131	50,573
	Total	80,301	2,341	7,520	10,466	20,327	727	281	101,636
May, 1935	North	43,600	1,376	3,667	4,355	9,398	401	149	53,548
	South	43,144	1,283	3,575	4,534	9,392	358	119	53,013
	Total	86,744	2,659	7,242	8,889	18,790	759	268	106,561
June, 1935	North	48,637	1,380	3,346	4,462	9,188	407	170	58,402
	South	47,982	1,332	3,288	4,456	9,076	376	162	57,596
	Total	96,619	2,712	6,634	8,918	18,264	783	332	115,998
July, 1935	North	48,680	1,462	2,893	3,793	8,148	392	155	57,375
	South	47,693	1,305	2,887	3,783	7,975	361	140	56,169
	Total	96,373	2,767	5,780	7,576	16,123	753	295	113,544
Aug , 1935	North	58,448	1,447	3,135	4,501	9,083	435	209	68,175
	South	58,582	1,376	3,019	4,808	9,203	415	177	68,377
	Total	117,030	2,823	6,154	9,309	18,286	850	386	136,552
Sept , 1935	North	46,728	1,361	2,999	4,448	8,808	394	169	56,099
	South	47,928	1,269	2,670	4,667	8,606	363	157	57,054
	Total	94,656	2,630	5,669	9,115	17,414	757	326	113,153

TABLE I—*Concluded*

Month and Year	Direction of Traffic Flow	Number of Vehicles Passing Station							
		Cars	Trucks				Busses	Misc	Total Traffic
			Class 1	Class 2	Class 3	Total			
Oct , 1935	North	45,309	1,282	3,070	4,408	8,760	397	122	54,588
	South	45,866	1,152	2,825	4,505	8,482	369	114	54,831
	Total	91,175	2,434	5,895	8,913	17,242	766	236	109,419
Total 12 Mo	North	488,211	14,266	38,031	52,185	104,482	4,748	1,651	599,092
	South	488,585	13,414	36,699	54,596	104,709	4,421	1,482	599,197
	Total	976,796	27,680	74,730	106,781	209,191	9,169	3,133	1,198,289
364 Day Ave	North	1,341	39	104	144	287	13	5	1,646
	South	1,342	37	101	150	288	12	4	1,646
	Total	2,683	76	205	294	575	25	9	3,292
Per Cent	Total	81 5	2 3	6 2	8 9	17 4	0 8	0 3	100 0

isolated A further attempt was made to sub-classify the heavy trucks into two classes, common carriers and free-lance, or contract carriers Since it was found impractical to do this accurately without stopping the trucks, data for this classification are omitted from the report

All items of traffic data were reported in hourly divisions for each of the two lines of traffic passing the station In addition to the record of traffic, the reports included a statement of weather and roadway conditions, and remarks regarding any unusual influence on the normal flow of traffic

The results of the survey are considered separately under four headings (1) study of the volume of traffic and its variations, (2) study of the classification of the traffic by kinds of vehicles, (3) study of the classification of the traffic by weight groups of vehicles, and (4) study of the classification of the vehicles by place of ownership

VOLUME OF TRAFFIC

Obviously the volume of traffic and the influences producing variations in volume, should be studied ahead of the data pertaining to the classification of traffic

Accordingly, there is presented in Table I a summary of all traffic passing the master station during its period of operation Figure 1 shows the daily volumes of automobile, truck and total traffic for each 24 hour period of the year

Of the total of 1,198,289 units of traffic, principally cars and trucks, 136,552, or 11 4 per cent, passed in August, 1935, the month of maximum movement Less than one-half of this amount, 61,264 or 5 1 per cent of the annual total, passed during January, 1935, the month of minimum movement of the period of the survey The average of the total traffic movement came in the month of March, 1935, when 99,857 or 8 33 per cent of the annual total passed the station In Table II the data just given has been summarized to show percentage relationships

In this report, the average 24-hour week day traffic volume will be the basis for describing traffic flow This is the average of volumes for the week days

TABLE II

SUMMARY OF TOTAL TRAFFIC PASSING STATION FOR YEAR PERIOD BEGINNING NOVEMBER 2, 1934, AND ENDING OCTOBER 31, 1935

Month and Year	Direction of Traffic Flow	Per Cent of Vehicles Passing Station							
		Cars	Trucks				Busses	Miscellaneous	Total Traffic
			Class 1	Class 2	Class 3	Total			
Total (12 Months)	North	40 7	1 2	3 2	4 3	8 7	0 4	0 2	50 0
	South	40 8	1 1	3 0	4 6	8 7	0 4	0 1	50 0
	Total	81 5	2 3	6 2	8 9	17 4	0 8	0 3	100 0
Maximum Month (August, 1935)	North	42 8	1 1	2 3	3 3	6 7	0 3	0 2	50 0
	South	42 9	1 0	2 2	3 5	6 7	0 3	0 1	50 0
	Total	85 7	2 1	4 5	6 8	13 4	0 6	0 3	100 0
Minimum Month (January, 1935)	North	37 6	1 2	4 2	6 4	11 8	0 7	0 1	50 2
	South	37 3	1 2	4 1	6 5	11 8	0 6	0 1	49 8
	Total	74 9	2 4	8 3	12 9	23 6	1 3	0 2	100 0
Average Month (March, 1935)	North	38 9	1 2	4 1	5 2	10 5	0 4	0 2	50 0
	South	38 6	1 1	4 0	5 8	10 9	0 4	0 1	50 0
	Total	77 5	2 3	8 1	11 0	21 4	0 8	0 3	100 0

TABLE III

MONTHLY VARIATION IN AVERAGE WEEKDAY TRAFFIC, THE PERCENTAGE OF TRUCKS, AND DISTRIBUTION BETWEEN NIGHT AND DAY TRAFFIC

Month and Year	No of Weeks Used	Average Weekday Total Traffic		Average Weekday Total Trucks		Per Cent of Trucks of Average Weekday Total Traffic		Per Cent of 24-Hour Total Traffic During 12 Hours 7 A M to 7 P M
		7 A M to 7 P M	24 Hours	7 A M to 7 P M	24 Hours	7 A M to 7 P M	24 Hours	
Nov , 1934	4	2186	2843	464	636	21 2	22 4	76 9
Dec , 1934	4	1753	2205	384	527	21 9	23 9	79 5
Jan , 1935	5	1661	2069	388	532	23 4	25 7	80 3
Feb , 1935	4	2123	2673	465	639	21 8	23 9	79 4
March, 1935	4	2394	3054	553	770	23 1	25 2	78 4
April, 1935	4	2370	3091	532	749	22 4	24 2	76 7
May, 1935	5	2385	3133	471	658	19 8	20 9	76 1
June, 1935	4	2623	3518	472	676	18 0	19 2	74 6
July, 1935	5	2384	3309	397	568	16 6	17 2	72 0
Aug , 1935	4	3001	4212	445	653	14 8	15 5	71 2
Sept , 1935	4	2665	3471	453	651	17 1	18 8	76 5
Oct , 1935	5	2447	3170	401	572	16 4	18 0	77 2
52-Week Average		2323	3051	449	632	19 3	20 7	76 1

Monday to Friday, inclusive Saturdays, Sundays and special days having been considered separately because of the abnormally high volumes of traffic recorded on such days The week day average, when freed of the influence of

these days, appears to show quite accurately and consistently the influence of the time of the month and the season of the year upon volume of traffic In Figure 2 the average week day for each week of the year has been shown, and compared to the average week day derived from the 52 average week days of the year The minimum value came in the week beginning January 21, 1935, at a time when the roadway, for more than half of the week, was covered with ice Similar conditions had affected the previous week, but to a lesser degree Snow drifts contributed to a low in December Extreme cold or other inclement weather conditions had little effect on the volume of traffic normal for the season if the roadway surface was in good condition The peak in week day averages on this chart came during the Iowa State Fair in August, at Des Moines, 35 miles from the station The range in weekly week day averages for the year is from a low of 1300 to a high of 6000, with an average of 3051

The week day averages on a monthly basis eliminate some of the peaks and valleys of the annual curve on the weekly basis and provide for a considerably smoother curve The data on this basis are shown in Table III and Figure 3, in which the annual week day average, 3051, is used as 100 per cent The week day average in this form is usable in the interpretation, correlation and coordination of counts at other stations at other times of the year, if the relation between volumes and composition of the traffic at those stations and the master station can be established The value for the week day average for each month, in terms of the annual week day average, thus becomes a useful and valuable traffic characteristic factor

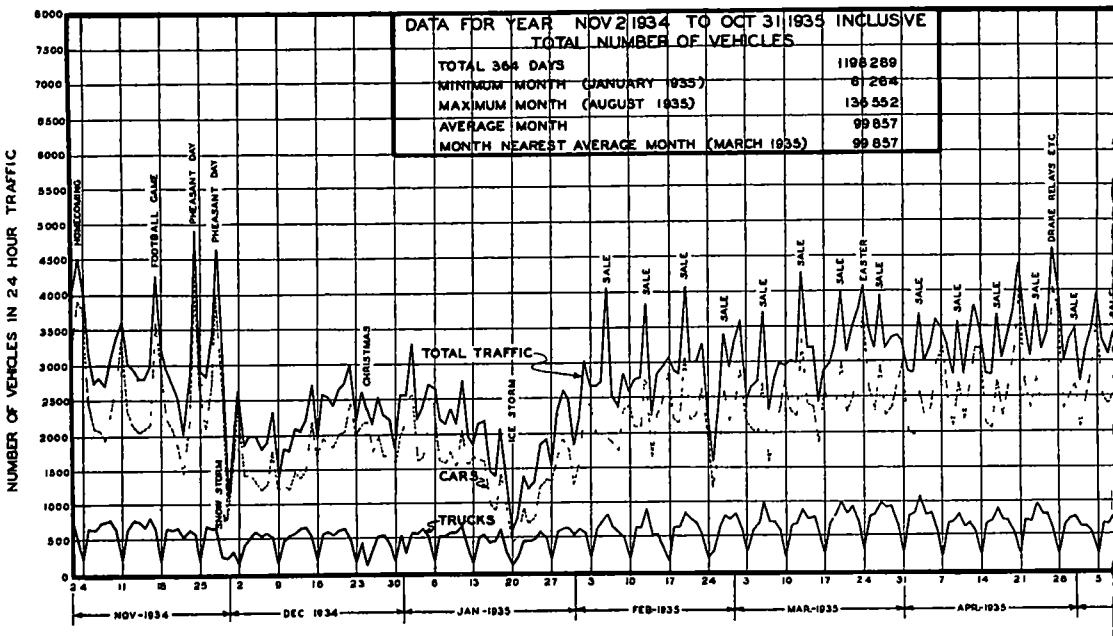


Figure 1 Daily Traf

In Figure 3 the curve is reasonably

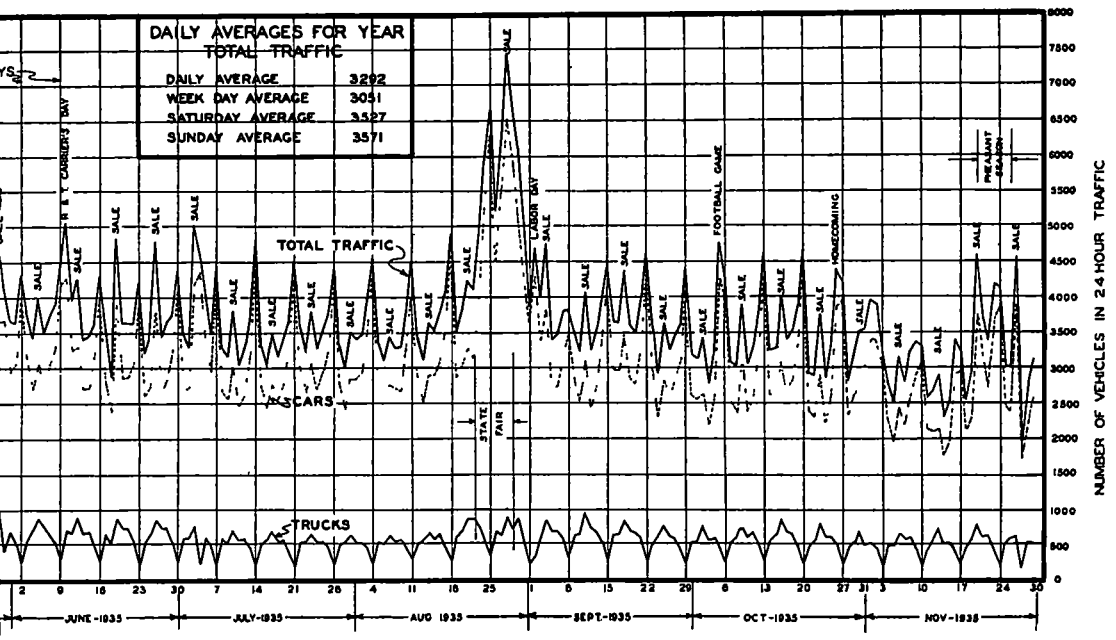
smooth It is noted that the monthly minimum week day average, occurring in December and January, is approximately 70 per cent of the annual week day average, and the maximum, occurring in August, is approximately 138 per cent of that value March, April, and May were found to have week day averages at or near the annual value The high for August is due to the State Fair, but the same week would show relatively high values at the majority of primary road stations in Iowa for the same reason

The Saturday and Sunday monthly averages also appear on Figure 3, and it is interesting to observe that they follow the same seasonal tendencies as found for the week days

A direct comparison of the monthly week day average traffic and monthly week end traffic is shown in Figure 4. The relationships are quite erratic from month to month, but in general the week end days have consistently greater total traffic than the week days The increase was due to a larger number of cars as the trucks were less in number on those days than on the week days

SUMMARY OF DISCUSSION ON VOLUME OF TRAFFIC

The volume of the average week day traffic has quite definite daily, weekly and monthly variations at this master station These variations appear to be regular occurrences in the seasonal cycle A similar effect was produced on the volume of week end traffic, but less consistently In general, the extent and direction of this variation from the annual average volume for the week day traffic seemed to be generally associated with the months of the year, each having its own peculiar effect. Inclement weather of considerable severity seemed to be the only weather condition to have



aster Traffic Station

much direct effect on the normal flow of traffic at any time of the year The condition of the roadway had a pronounced effect Since, at this station, there were bad roadway conditions only during parts of two weeks, the effect might be overlooked, but more extensive experience in the state-wide survey substantiates the observations on this point at the master station

CLASSIFICATION BY KIND OF VEHICLES

After an examination of the traffic stream as a whole, its composition should be examined Classification by kinds of vehicles will be considered first. The recorders classified the units of traffic as they passed into four general groups, cars, trucks, buses, and miscellaneous The trucks were divided at the same time into three classes: Class 1, ½ to 1 ton

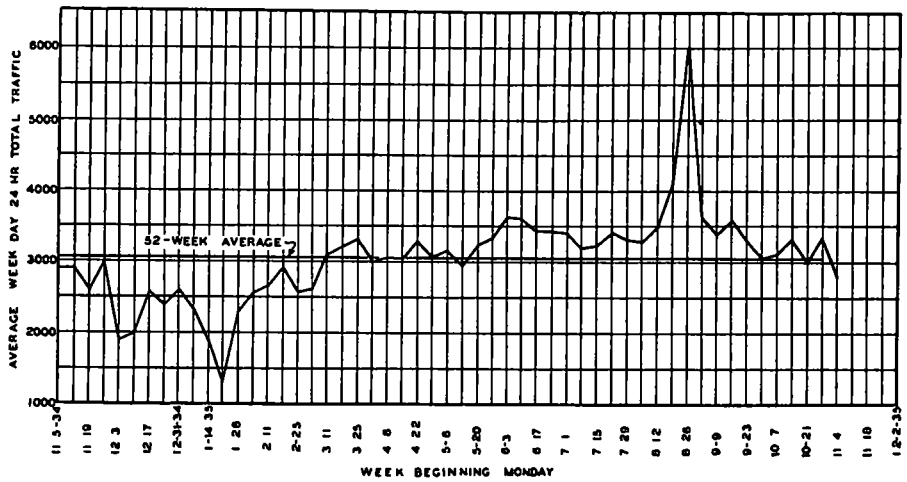


Figure 2. Weekly Variation in Traffic Volume at Master Station

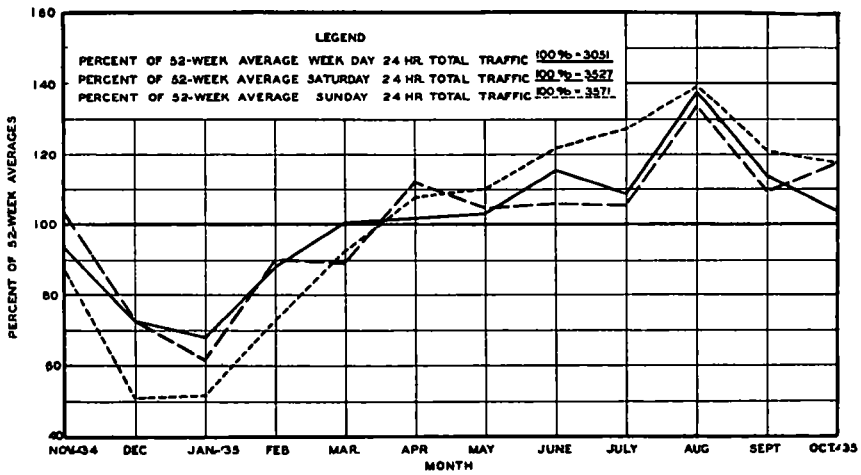


Figure 3. Seasonal Variation in Traffic Volume at Master Station

capacity, Class 2, 1½ to 2½ tons capacity, and Class 3, 3 tons and greater capacity

Tables I and II show the salient features of these types of traffic, and Figures 5 and 6 present some of the data graphically

Of the total number of units of traffic passing this station during the year period, 81 5 per cent were cars, 17 4 per cent were trucks, 0 8 per cent were buses, and 0.3 per cent were miscellaneous

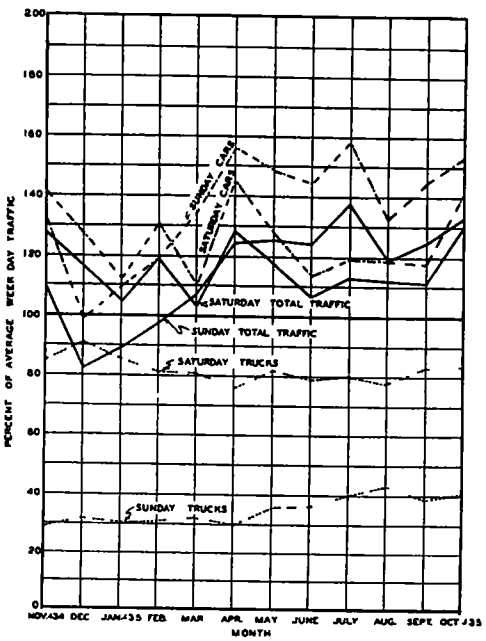


Figure 4 Week End Traffic as Related to Average Week Day Traffic at Master Station

vehicles and equipment These percentages are for the whole traffic for the whole year Since it is one of the purposes of this report to put the data obtained in a form useful to a state-wide traffic survey, and since the data for that survey were most conveniently and efficiently obtained, compared and studied on an average week day basis, the discussion of classification by kind of vehicle must also be kept on that basis

On this average week day basis, it was found (see Table IV) that cars were 78 3 per cent of the total traffic, trucks, 20 7 per cent, buses, 0 7 per cent, and miscellaneous, 0 3 per cent On Saturdays and Sundays the car percentage was considerably increased In Figure 5 are found the weekly variations in the number of trucks for the week day average and the variation in the percentage of the week day average total traffic The maximum number for an average week day was 869, the minimum 401, and the average of the average week days was 632. The percentage variation is quite erratic since it is dependent upon the number of cars as well as the number of trucks The maximum was found to be 33 6 per cent, the minimum 12 1 per cent, and the average 20 7 per cent

When considered on a monthly basis, as shown in Table IV and Figure 6, the seasonal trends are more readily discernible The percentage of trucks makes a smoother and more usable curve The average week day number of trucks on this basis also loses some of its peaks and valleys, but maintains a different slope than that of the percentage, showing that as compared to the variation in number of trucks for the monthly average week day, the variation in cars is much greater In Figure 7 this comparison has been made graphically to the same scale for cars and trucks

In Figure 6 it will be noted that the percentage of trucks for the 24-hour period is greater than for the 12-hour day period Thus, indirectly, it is shown that the percentage of trucks at night was greater than for the days, consistently throughout the year

The classification of the traffic by kind of vehicles for the state-wide survey gave results similar to those for the master

station For the 151 24-hour control stations the average week day traffic consisted of 75 6 per cent cars, 22 7 per cent trucks, and 1 7 per cent buses and miscellaneous traffic combined. For the twelve-hour period of the 151 24-hour control stations and the 1178 12-hour stations, the average twelve-hour week-

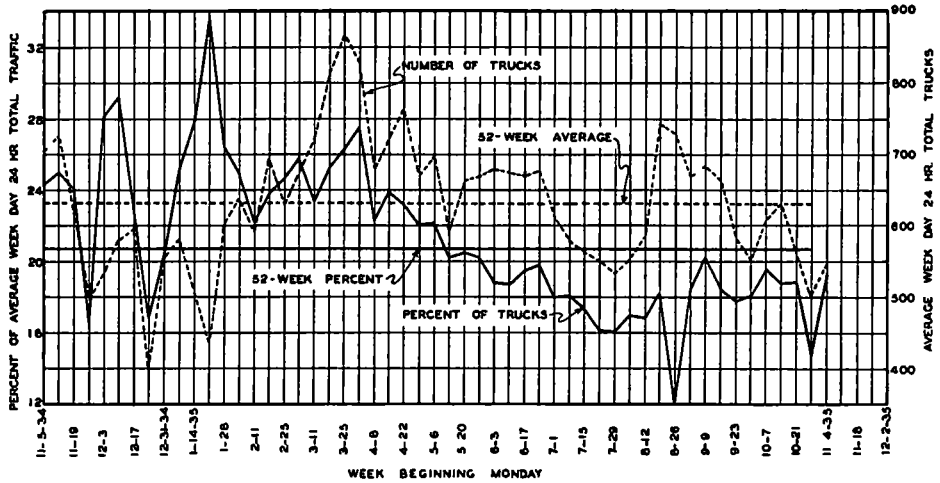


Figure 5. Weekly Variation of Truck Traffic Past the Master Station

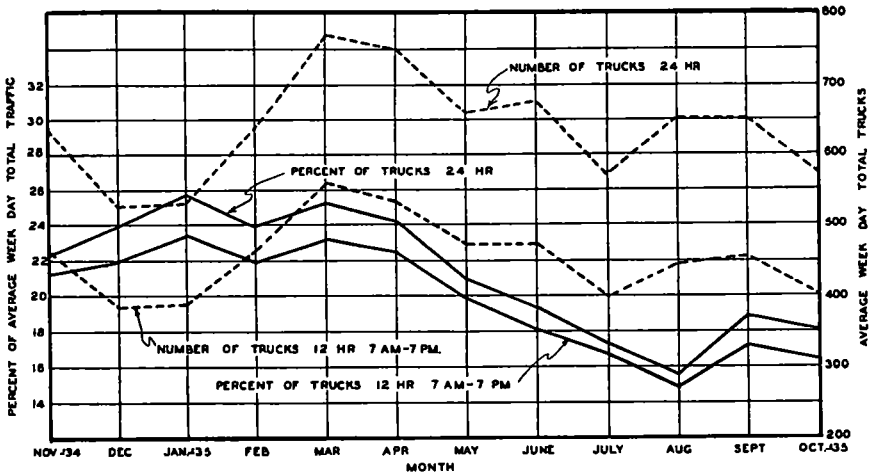


Figure 6. Seasonal Variation of Truck Traffic Past the Master Station

cellaneous combined. For the 12-hour period of the 151 24-hour control stations the average twelve-hour weekday traffic was composed of 74 7 per cent cars, 23 4 per cent trucks, and 1 9 per cent buses day traffic was composed of 74 3 per cent cars, 23 0 per cent trucks, and 2 7 per cent buses and miscellaneous traffic combined For the same period, the master station figures on 24-hour basis were:

74 2 per cent cars, 24 6 per cent trucks, and 1 2 per cent buses and miscellaneous combined.

the year The data are shown in tabular form in Table V It is of interest to note that the heavy class produced 52 4

TABLE IV

COMPARISON OF AVERAGE 24-HOUR WEEK DAY TRAFFIC WITH WEEK-END TRAFFIC AT MASTER STATION

Month and Year	Per Cent of Total Vehicles Passing Station						Per Cent of Average Week Day					
	Ave Week Day		Saturday		Sunday		Saturday			Sunday		
	Cars	Trucks	Cars	Trucks	Cars	Trucks	Cars	Trucks	Total	Cars	Trucks	Total
Nov , 1934	76 6	22 3	84 2	14 8	92 9	5 8	140 8	84 6	128 0	132 7	28 5	109 2
Dec , 1934	74 7	23 9	79 6	18 7	89 2	9 0	126 8	90 9	115 8	98 2	31 1	82 0
Jan , 1935	72 6	25 7	77 5	20 9	89 5	8 7	111 2	85 0	104 2	109 4	30 0	88 8
Feb , 1935	74 9	23 9	82 4	16 2	91 2	7 4	130 6	80 4	118 6	118 2	30 3	97 1
Mar , 1935	73 8	25 2	78 8	19 8	92 0	7 5	109 5	80 5	102 2	133 6	31 7	107 5
Apr , 1935	74 8	24 2	84 5	14 3	93 5	5 7	144 2	75 5	128 0	155 1	29 0	124 0
May, 1935	78 1	21 0	84 4	14 0	93 0	5 9	127 0	81 2	117 0	148 0	35 0	125 0
June, 1935	79 9	19 2	84 9	14 1	93 4	5 5	113 0	78 1	106 0	144 0	35 5	123 5
July, 1935	81 9	17 2	86 8	12 2	94 1	4 9	119 0	79 8	112 3	157 6	39 1	137 2
Aug , 1935	83 6	15 5	88 2	10 8	93 6	5 6	118 1	77 8	111 9	132 3	42 6	118 2
Sept , 1935	80 3	18 8	84 9	14 0	93 2	5 8	117 2	82 5	111 0	144 4	38 4	124 4
Oct , 1935	81 0	18 0	87 4	11 5	93 6	5 5	140 8	83 4	130 5	153 4	40 4	132 7
52-Week Average	78 3	20 7	84 3	14 6	92 8	6 1	124 5	81 3	115 6	138 8	34 3	117 0

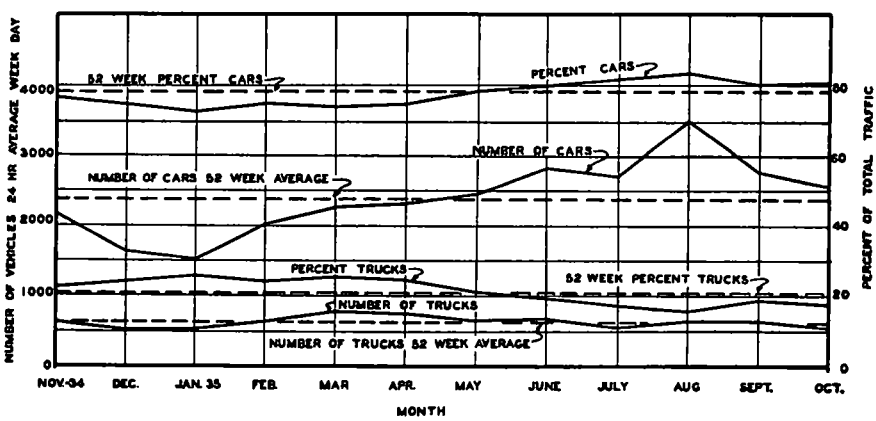


Figure 7. Seasonal Variation in Car and Truck Traffic Past the Master Station

TRUCK TRAFFIC

A brief inspection of the composition of the truck traffic itself at the master station reveals little variation throughout

per cent, the medium class 34 5 per cent, and the light class, 13.1 per cent of the total truck traffic passing station for the average week day

Again there is similarity between the master station and the state-wide stations The control stations on 24-hour basis gave the division of truck traffic as 21 4 per cent Class 1, 43.2 per cent Class 2, and 35 4 per cent Class 3 trucks The corresponding figures for the twelve-hour period of the control stations were: 23 9 per cent for Class 1, 46 1 per cent for Class 2, and 30 0 per cent for Class 3. The values for the 12-hour count at all stations in the state-wide count were 20 8 per cent for Class 1, 49 0 per cent for Class 2, and 30 2 per cent for Class 3 trucks These values seem reasonable, as more heavy freight lines pass the master station than the majority of the other stations

It is of interest here to compare the relative road use of the different groups of vehicles as derived from the traffic and motor vehicle registration figures. For example, the state-wide survey indicated for the winter months that the total traffic on the primary roads, obtained by combining the data from the 12-hour and 24-hour stations, consisted of approximately 74 3 per cent cars, 23 0 per cent trucks and 2 7 per cent buses and miscellaneous combined These figures, computed to the annual average week day basis from data available at the master station, would give 78 4 per cent cars, 19 4 per cent trucks, and 2 2 per cent buses and miscellaneous combined, as the composition of the annual average week day traffic

The registration classification is made only for cars, trucks, trailers, and motorcycles. The percentages of each for 1934 were 87 6 per cent cars, 11 6 per cent trucks, 0 5 per cent trailers, and 0 3 per cent motorcycles Buses are included in the car registration Therefore, the car and motorcycle percentages may be added, without serious error, for direct

TABLE V

CLASSIFICATION OF TRUCK TRAFFIC PASSING MASTER STATION

Month and Year	Average Weekday Truck Traffic 7 A M to 7 P M				Per Cent of Total Trucks 7 A M to 7 P M			Average Weekday Truck Traffic 24 Hour				Per Cent of Total Trucks 24 Hour		
	Class 1	Class 2	Class 3	Total Trucks	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3	Total Trucks	Class 1	Class 2	Class 3
Nov , 1934	64	177	223	464	13 8	38 1	48 1	76	213	347	636	12 0	33 5	54 5
Dec , 1934	51	152	181	384	13 3	39 6	47 1	60	184	283	527	11 4	34 9	53 7
Jan , 1935	48	156	184	388	12 4	40 2	47 4	55	189	288	532	10 3	35 5	54 2
Feb , 1935	61	197	207	465	13 1	42 4	44 5	71	240	328	639	11 1	37 6	51 3
Mar , 1935	68	227	258	553	12 3	41 0	46 7	79	280	411	770	10 3	36 4	53 3
Apr , 1935	70	211	251	532	13 1	39 6	47 3	83	264	402	749	11 1	35 2	53 7
May, 1935	77	198	196	471	16 3	42 1	41 6	94	245	319	658	14 1	37 3	48 6
June, 1935	78	183	212	472	16 5	38 7	44 8	96	233	347	676	14 2	34 5	51 3
July, 1935	74	151	172	397	18 6	38 0	43 4	96	192	280	568	16 9	33 8	49 3
Aug , 1935	79	159	207	445	17 7	35 8	46 5	99	208	346	653	15 2	31 8	53 0
Sept , 1935	81	161	211	453	17 9	35 5	46 6	99	201	351	651	15 2	30 9	53 9
Oct , 1935	66	147	188	401	16 4	36 6	47 0	81	185	306	572	14 1	32 4	53 5
52-Week Year	68	175	206	449	15 1	39 0	45 9	83	218	331	632	13 1	34 5	52 4

comparison with the truck, bus, and miscellaneous percentages of traffic When this is done it is found that the registration contains 87 9 per cent in the car group and 11 6 per cent in the truck group Trailers are omitted Then in the annual average week day traffic movement on the primary road system there would be 80 6 per cent in the car group and 19 4 per cent in the truck group From these relationships it may be computed that the average truck uses the primary road about 1 82 times as much as the average car If the average car travels 8,000 miles on the primary road, the average truck travels 14,560 miles

SUMMARY CLASSIFICATION BY KIND OF VEHICLES

The day of the week, the month of the year, and roadway conditions were the principal factors found to have an influence on the composition of the traffic stream The cars seemed to be more responsive generally to these factors than the trucks However, the truck flow was greatly reduced on Saturdays and Sundays Much of the truck traffic passing this station consists of freight lines maintaining regular schedules, and much of it consists of contract trucks following the same general routing as the common carriers These factors may have contributed greatly to the consistency of flow for this class of traffic However, it was noted in the state-wide survey that truck movements were generally more consistent than car movements The similarity between the composition of this traffic at the master station and at the outlying stations indicated that the master station traffic was quite generally typical of the traffic on the primary road system

CLASSIFICATION BY WEIGHT OF VEHICLE

Since information concerning weights of traffic was not acquired in the field work, estimated weights were applied to the classification by kind of vehicle In the work of Robley Winfrey, presented in Bulletin 114, Engineering Experiment Station, Iowa State College, gross weights of the different kind and capacity groups of motor vehicles in Iowa were obtained for the 1932 registration The weights as shown are quite obviously less for each group than for the present day vehicles although they are believed to be of about the same relative order In these circumstances the estimated weights can be applied to the present classification by kind and weight groups for the determination of the relative weight classification of the traffic stream

In Table VI the monthly week day averages of the number of vehicles have been computed to the weight basis It will be noted that of the total average week day traffic at the master station, 50 1 per cent by weight was produced by cars, buses and miscellaneous groups, and 49 9 per cent was produced by trucks These figures are directly comparable to 79 3 per cent by the number of cars, buses and miscellaneous, and 20 7 per cent by the number of trucks

Considering the entire number of vehicles passing the station during the year period, it is found that cars, buses and miscellaneous contribute 55 6 per cent of the total traffic by weight, and trucks contribute 44 4 per cent by weight These figures are directly comparable to 82 6 per cent by number of cars, buses and miscellaneous, and 17 4 per cent by number of trucks

It is interesting to note the weight relationships for the state-wide survey

TABLE VI

GROSS TONS OF TRAFFIC FOR AVERAGE 24-HOUR WEEKDAY AT THE MASTER STATION

Month and Year	Average Weekday 24-Hour Traffic						Gross Tons of Traffic (Average 24-Hour Weekday Traffic)						Per Cent of Total Gross Tons (Ave 24-Hour Weekday Traffic)				
		Trucks						Trucks						Trucks			
	Cars*	Class 1	Class 2	Class 3	Total	Total Traffic	Cars*	Class 1	Class 3	Class 3	Total	Total Traffic	Cars*	Class 1	Class 2	Class 3	Total
Nov , 1934	2207	76	213	347	636	2843	3207	180	820	2575	3575	6782	47 3	2 6	12 1	38 0	52 7
Dec , 1934	1678	60	184	283	527	2205	2438	142	708	2100	2950	5388	45 3	2 6	13 1	39 0	54 7
Jan , 1935	1537	55	189	288	532	2069	2233	130	728	2137	2995	5228	42 7	2 5	13 9	40 9	57 3
Feb , 1935	2034	71	240	328	639	2673	2955	168	924	2434	3526	6481	45 5	2 6	14 2	37 7	54 5
March, 1935	2284	79	280	411	770	3054	3319	187	1078	3050	4315	7634	43 5	2 4	14 1	40 0	56 5
April, 1935	2342	83	264	402	749	3091	3403	197	1016	2983	4196	7599	44 8	2 6	13 4	39 2	55 2
May, 1935	2475	94	245	319	658	3133	3596	223	943	2367	3533	7129	50 5	3 1	13 2	33 2	49 5
June, 1935	2842	96	233	347	676	3518	4129	228	897	2575	3700	7829	52 7	2 9	11 5	32 9	47 3
July, 1935	2741	96	192	280	568	3309	3983	228	739	2078	3045	7028	56 7	3 2	10 5	29 6	43 3
Aug , 1935	3559	99	208	346	653	4212	5171	235	801	2567	3603	8774	59 0	2 6	9 1	29 3	41 0
Sept , 1935	2820	99	201	351	651	3471	4097	235	774	2604	3613	7710	53 1	3 1	10 0	33 8	46 9
Oct , 1935	2598	81	185	306	572	3170	3775	192	712	2271	3175	6950	54 3	2 8	10 2	32 7	45 7
52-Week Average	2419	83	218	331	632	3051	3515	197	839	2456	3492	7007	50 1	2 8	12 0	37 1	49 9
Average of 364 Days of Year	2717	76	205	294	575	3292	3948	180	789	2181	3150	7098	55 6	2 5	11 1	30 8	44 4
Average Weekday Traffic (Winter Survey)																	
1 Master Station	1895	65	222	329	616	2511	2753	154	855	2440	3449	6202	44 4	2 5	13 8	39 3	55 6
2 State-Wide Average	603	38	90	55	183	786	876	90	346	408	844	1720	50 9	5 2	20 1	23 8	49 1

* Note Busses and miscellaneous traffic are included under the heading "Cars" in the above tabulation

Note Average Gross Weights used in calculations

Cars	1 453 Tons
Class 1 Trucks	2 37 Tons
Class 2 Trucks	3 85 Tons
Class 3 Trucks	7 42 Tons

During the winter months covered by the survey, the master station traffic, on a weight basis, contained 44 4 per cent cars and 55 6 per cent trucks These figures are directly comparable to 75 4 per cent cars and 24 6 per cent trucks, on a numerical basis For the state-wide stations, the average 24-hour week day traffic contained 50.9 per cent cars and 49 1 per cent trucks on a weight

basis These figures are directly comparable to 77 per cent cars and 23 per cent trucks on a number basis

It will be noted that the annual average week day relationship at the master station was 50 1 per cent cars by weight, and 49 9 per cent trucks, as derived from 79 3 per cent in the car group and 20 7 per cent in the truck group, on a number basis If the assumption be made that a similar change took place in the statewide traffic, the relationship would be 56 7 per cent, by weight, in the car group and 43 3 per cent in the truck group

Further, the relationships by registration were found to be 87 9 per cent in the car group and 11 6 per cent in the truck group An examination of a statement of the estimated income from each revealed that the car group contributed 75 1 per cent, and the truck group 24 9 per cent, of the total motor vehicle revenue produced annually under the present laws of the State of Iowa

SUMMARY OF CLASSIFICATION BY WEIGHT OF VEHICLE

Some of the components of the traffic stream remain practically constant in their relationship to the total traffic throughout the year This is demonstrated particularly by the Class 1 and Class 2 trucks on the weight basis, as well as on the number basis The disproportionate increase of the car traffic and the relative constancy in number of the heavy trucks during the summer and early fall months causes the only appreciable change during the year in the relationships of the traffic groups when considered on the weight basis This was particularly noticeable for the months of July, August, September and October The relationships by weight of 55 6 per cent for the car, bus, and miscellaneous group and 44 4 per cent for the trucks for the year period is believed to be a close approximation of the true relationship The relationship by weight for average week day traffic of 50 1 per cent for the car, bus, and miscellaneous group and 49 9 per cent for the truck group is also believed to be quite close to the true weight relationship for the traffic on the primary road system, during the winter months, since directly comparable figures during the period of the statewide survey show the master station average week day traffic composition, by weight, to be 44 4 per cent cars and 55 6 per cent trucks, and the state-wide 1389 station average week day composition to be 50 9 per cent cars and 49 1 per cent trucks, by weight

CLASSIFICATION BY PLACE OF OWNERSHIP

Some additional information regarding the traffic movement was obtained from a study of the place of ownership of the traffic units passing the station On two days of each week enough license number observations were made to obtain the name of the county of Iowa-owned vehicles, and the name of the State for all others

The data thus obtained were classified in seven zones the local county, the county nearest the station, the remainder of the counties adjacent to the county in which the station was located, the counties adjacent to those counties, the rest of the State of Iowa, the States adjacent to Iowa, and the rest of the United States

It was found that even for this station, located on one of the principal through routes of the primary road system, the major part of the traffic was produced by local vehicles Approximately 33 0 per cent came from the local county, 24 0 per

cent from the county nearest the station, 10 0 per cent from the adjacent counties, 7 0 per cent from the next ring of counties, about 13 0 per cent from the rest of the State, 11 0 per cent from adjacent States, and 2 0 per cent from the rest of the United States

In other words about 68 per cent of the average week day traffic was due to vehicles owned within a radius of 36 miles about the station as a center, and 75 per cent came within a radius of 60 miles The maximum through traffic came, as might be expected, in the summer particularly in August when 18 per cent was from out of the State, principally from adjacent States The remainder of the United States contributed slightly more than one-fourth of the out-of-State traffic at all times Traffic at the stations of the state-wide survey was also found to be predominantly local

THE DAILY TRAFFIC PATTERN

To conduct a traffic census for 24 hours per day for 5 to 7 days at enough stations to obtain the annual average week day flow and probable maximum flow for each section of the system would be very costly A reliable sampling method that will reduce the cost without seriously affecting the accuracy of the results is desirable One of the functions of the master station is derivation of factors for shorter counts than that just described

The data of most promise for that purpose seems to be the daily traffic patterns for the entire 24 hours Some assistance may be derived from the day-night division of the traffic volume As the latter requires less discussion, it is presented first

Tables III and V contain data on this classification of the traffic stream Its principal variation seems to be due to the season of the year Of the total average week day traffic, the portion passing between the hours of 7 A M and 7 P M reached a maximum of 80 3 per cent in January, 1935, and a minimum of 71 2 per cent in August, 1935 The average for the year period was 76 1 per cent of the average week day traffic

A comparison of the values obtained at the master station during the period of the state-wide survey reveals a great similarity in the general traffic movements on all parts of the primary road system During this period the master station average week day traffic was divided between the day and night twelve hour periods in practically the same manner as the average for the outlying stations At the master station 79 5 per cent of the average week day traffic passed in the daytime between 7 A M and 7 P M , and the average for the 151 24-hour, 14-day control stations, excluding local roads, was 79 9 per cent for this portion of the day

Yet, since 12 hours is an unwieldy portion of the day for use in a traffic survey, consideration must be given to some other fraction The traffic patterns shown in Figure 8 were examined and analyzed The average pattern for the master station is shown both for the year period and for the period of the state-wide survey, and the average pattern for the 151 control stations is shown, revealing their similarity The year period master station pattern departs somewhat from the other two, due to the same influence affecting the change in the ratio of day to night traffic

Since there is a tendency towards concentration of traffic in the daytime during the winter, and of more uniform distribution over the whole 24-hour day

in summer, there is a slightly different daily traffic pattern for the summer months than for the winter The spring and fall months were transitions between these two extremes For the winter months, November to February, the peak in the flow came in the hour from four to five P M , in which 8 to 9 per cent of the total traffic of the day passed the station In the spring the peak in the flow moved to the hour between five and six P M , for the remainder of the year period, with an increasing tendency towards uniformity of flow as summer approached, and a tendency toward the winter concentration as it passed The change from month to month was slight, but definite

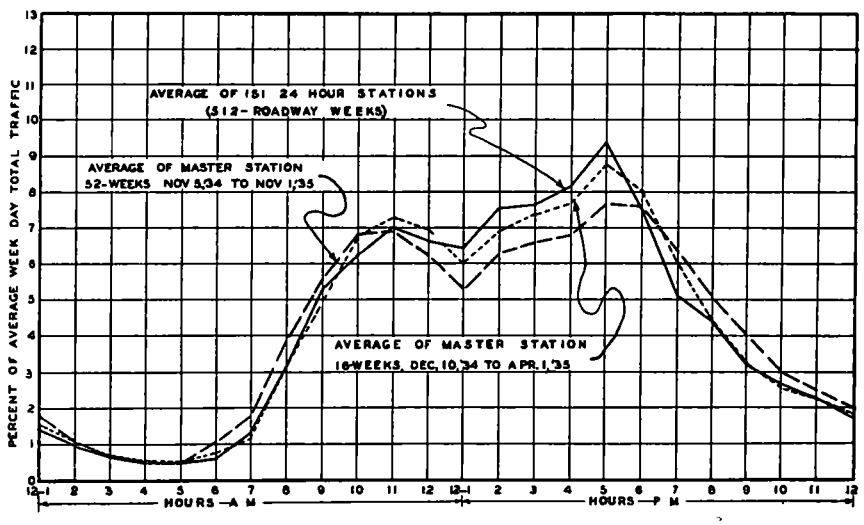


Figure 8. Highway Traffic Flow Patterns. Comparison of Master Station with Average of State Winter Count 1934–35

A statistical analysis of the week days within the month reveals that the variation from day to day is small For use in the state-wide survey, a statistical analysis was made of the groups of week days in the 4-month period of the survey from December, 1934 to March, 1935, inclusive Part of the data derived are shown in Figure 9 The average week day pattern for the period, the maximum hourly percentage, the minimum hourly percentage, and the standard deviation of each hourly percentage are shown The close grouping at each hourly percentage indicates a high degree of uniformity in the hourly values from day to day It will be noted that convenient groupings of the hourly percentages may be made For example, between the hours of 7 A M and 12 noon, 28 9 per cent of the total traffic of the average week day passed, between 8 A M and 12 noon, 25 8 per cent, between one and five P M , 30 6 per cent, and between one and six P M , 38 6 per cent

In Figure 10, the data for the 151 24-hour, 14-day control stations have been shown for comparison There is a greater spread in the hourly departures from the average, but reference to Figure 8 will recall the close agreement of the average patterns Here, also, conveni-

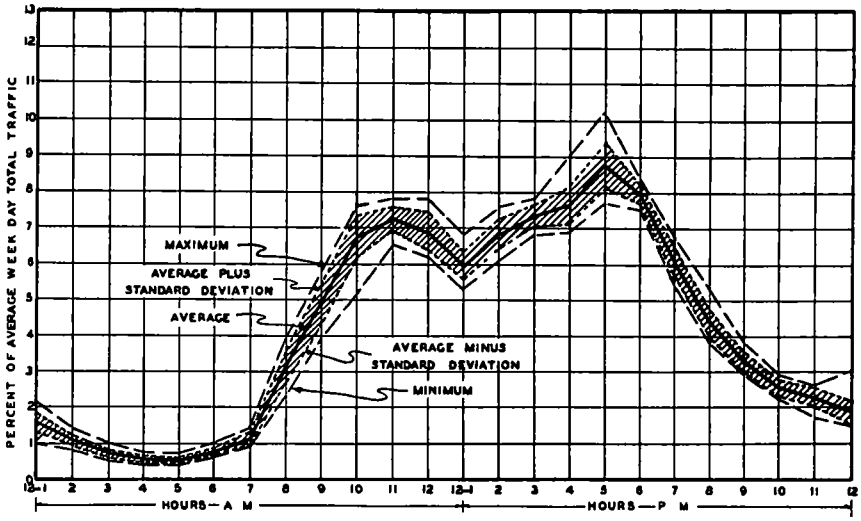


Figure 9. Highway Traffic Flow Patterns Master Station Winter Count 16 Weeks Dec. 10, '34–Apr 1, '35

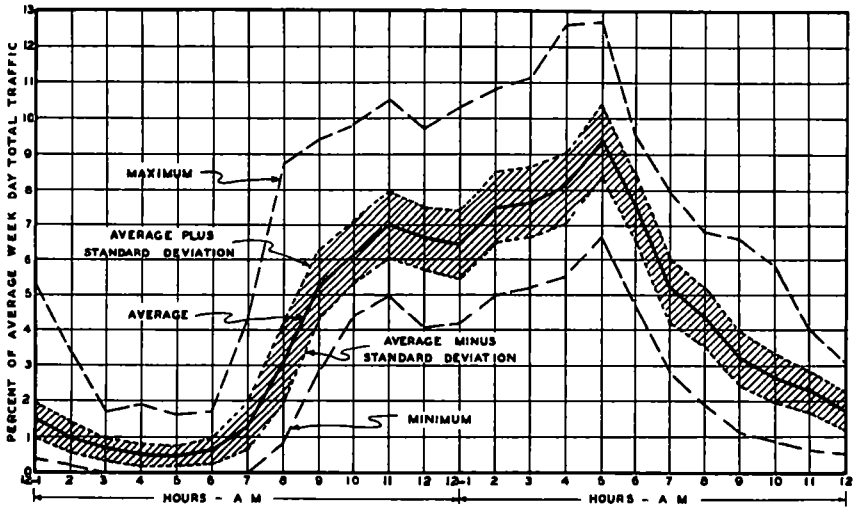


Figure 10. Highway Traffic Flow Patterns Derived from Average of 151 24-Hr. Count Stations Including 512 Roadway Week—Dec. 10, '34–Apr. 1, '35

ent groupings of the hourly averages may be made for comparison with the master station data For example, between the hours of 7 A M and 12 noon, 28 2 per cent of the total traffic of the average week day passed these 151 stations; between 8 A M and 12 noon, 25 1 per cent, between one and five P M , 32 6 per cent, and between one and six P M , 40 2 per cent, all of which are in close

agreement with the values for similar portions of the day at the master station for the same period

USE OF THE DATA

The similarities between the master station and the 24-hour control stations which were uniformly distributed over the primary road system indicated that the principal objective of the operation of the master station might be partly realized It was conceived that, when traffic was moving normally on the primary road system in all parts of the State, there would be a definite relationship between the volume and composition of the traffic stream at each of the stations, and that at the master station; and as the habits, customs, and activities of the people were similar, that the daily traffic patterns would be similar.

To try out this theory, computations were made to determine the relationships between the master station and each of the control and 12-hour, 5-day stations for similar periods and conditions of operation When this had been done the observations of the other stations were brought to a common period of observation, the last week of March, 1935, which is, incidentally, the average week of the year period of operation of the master station

When this had been done for all stations, a flow map was prepared showing the traffic on all sections of the primary road system as if it had been determined during the week beginning March 25, 1935 The process just described is long and tedious, but when the flow map was completed it was found to be remarkably consistent [1]

Other tests of the accuracy in the use of the master station data were made in the computation of the short counts obtained in June and July for eight counties which had been omitted from the statewide winter count It was desired that the flow map be complete, but the only means of providing the needed data was that of short counts of 4 to 8 hours, once at each of the stations omitted Also, it was thought advisable to check at a number of the stations counted previously It is apparent that the results were far from satisfactory

Since at this time the farmers were extremely busy with cornplowing and hay harvesting, roads used almost exclusively by rural groups gave results absurdly low in comparison with winter counts The result was that the average value for the volume of traffic at this group of stations was only 84 0 per cent of the volume as determined by the winter counts

During the winter a number of recounts were made for either one or two week periods as the schedule required Typical results of the computations for these are shown in Table VII Table VIII shows typical comparisons of summer short count recounts to the winter survey.

A special series of checks on the accuracy of the use of the master station data was made in the winter months, January, February, and March, 1935, and in October, 1935 Some of the data are shown in Table IX where it will be noted that the volume check on the group of stations gave, on the recount, a departure of 2 9 per cent The maximum individual departure on the primary road was 10 8 per cent, and for a county or side road, 25 5 per cent These values compare favorably with those of the other recounts

[1] See Figure 5, page 28

TABLE VII

COMPARISON OF RECOUNTS TO FIRST COUNT—WINTER TRAFFIC SURVEY

(All counts computed to week of March 25, 1935, using Master Station factors)

Station Number	Location of Station	Roadway	Dates Counted				Average Actual Week Day Total Traffic				Average 2-Hour Total Traffic Computed to Week of 3/25/35		Per Cent Recount of First Count (Week of 3/25/35)
			First Count		Recount		1st Count		Recount				
			Week Beginning Monday	No of Wk Da	Week Beginning Monday	No of Wk Da	12-Hour	24-Hour	12-Hour	24-Hour	First Count	Re-Count	
3–8	Intersection of	#13 E	2/11/35	5	3/25/35	5	206		237		321	296	92 2
	#51 & #13,	#13 & 51N	2/11/35	5	3/25/35	5	376		447		586	559	95 5
	S E of Waukon	#51 S	2/11/35	5	3/25/35	5	220		248		342	310	90 6
7–8	W Edge, Waterloo	#218	12/31/34	7	2/27/35	3	1065		1627	2192	1803	2312	128 2
10–4	E Edge, Independence	#20	12/24/34	5	3/25/35	5	807		1174	1462	1401	1462	104 0
10–5	W Edge, Independence	#20	1/28/35	5	3/18/35	5	856		1340	1774	1546	1821	117 9
10–8	S Edge, Independence	#11	2/11/35	5	3/11/35	5	673		769	978	1049	1044	99 5
14–2	S Edge, Carroll	#71	12/24/34	5	2/11/35	5	585	789	548	716	1048	1095	104 3
22–23	Junction of #13	#13 N	1/ 7/35	5	3/ 4/35	5	286		341		510	539	105 8
	and #128,	#128 E	1/ 7/35	5	3/ 4/35	5	290		263		517	416	80 4
	North of Elkader	#13 S	1/ 7/35	5	3/ 4/35	5	525		543		936	858	91 7
22–24	Junction of #13	#13 SW	12/24/34	4	3/11/35	5	174		336		302	449	148 8
	and #52 (South	#13 & 52N	12/24/34	4	3/11/35	5	406		523		706	699	99 0
	Junction)	#52 SE	12/24/34	4	3/11/35	5	232		300		403	401	99 6
22–25	Junction of #18	#18 & 52W	12/24/34	4	3/18/35	5	427		521		742	669	90 2
	and #52 (W	#18 E	12/24/34	4	3/18/35	5	195		212		339	272	80 3
	Point of Junction)	#52 S	12/24/34	4	3/18/35	5	232		309		403	398	98 8
26–1	Jct #3 & Co Rd	#3 W	1/ 7/35	5	2/18/35	10	364	425	485	577	606	697	115 0
	1½ Mi East of	#3 S	1/ 7/35	5	2/18/35	10	345	404	448	534	576	645	112 0
	Bloomfield	Go Rd E	1/ 7/35	5	2/18/35	10	27	28	44	50	40	60	150 0
28–4	E Edge, Manchester	#20	12/24/34	4	3/25/35	5	716		1026	1290	1247	1290	103 3
28–9	N Edge, Manchester	#13	1/14/35	5	3/18/35	5	666		692	888	1492	913	61 1

SUMMARY OF USE OF DATA

It was demonstrated that the data might successfully be used for the correlation of the counts for the majority of the stations recounted, and for the determination of the total traffic movement A number of individual stations gave large departures from the first count, but in each of these instances comparisons of the actual counts for the same periods were found to be greatly at variance The departure is therefore more directly chargeable to variations of the basic data than to the method of

TABLE VIII

COMPARISON OF SUMMER SHORT COUNT RECOUNTS TO WINTER SURVEY

Sta Number	Location	Roadway	Date of Short Count: Day	Date of Short Count: Date 1935	Time	Actual Count Total Traffic	Factor to Adjust to 24 Hours	Calc 24-Hour Total Traffic	Factor to Adjust to Week of 3/25 1935	Calc Ave 24-Hr Week Day Total Traffic for Wk of 3/25/35: From Short Count	Calc Ave 24-Hr Week Day Total Traffic for Wk of 3/25/35: From Winter Count	Per Cent Recount of First Count (Wk 3/25 1935)
11–7	Intersection #5 and Co Rd, N W edge of Alta	#5 W	Tue	6/25	8A–Noon	181	25 1	721	103 9	694	808	85 9
		#5 S	Tue	6/25	8A–Noon	157	25 1	625	103 9	601	753	79 8
		Co Rd, N City St	Tue	6/25	8A–Noon	75	25 1	299	103 9	288	357	80 7
		East	Tue	6/25	8A–Noon	117	25 1	466	103 9	448	537	83 5
21–1	Junction #10 & Co Rd, 1 Mi W of Peterson	#10 E	Wed	6/26	8A–Noon	120	25 1	478	103 9			
		#10 E	Wed	6/26	1–5 P M	104	32 6	319	103 9			
						Average		399	103 9	384	519	74 0
		#10 W	Wed	6/26	8A–Noon	70	25 1	279	103 9			
		#10 W	Wed	6/26	1–5 P M	59	32 6	181	103 9			
						Average		230	103 9	222	279	79 6
		Co Rd, S	Wed	6/26	8A–Noon	52	25 1	207	103 9			
		Co Rd, S	Wed	6/26	1–5 P M	49	32 6	150	103 9			
						Average		179	103 9	172	293	58 7
21–11	Intersection #18, #170 & Co Rd, 2 Mi North of Everly	#18 E	Wed	6/26	8A–Noon	206	25 1	820	103 9	790	638	123 9
		#18 W	Wed	6/26	8A–Noon	208	25 1	828	103 9	797	685	116 2
		#170 S	Wed	6/26	8A–Noon	132	25 1	526	103 9	506	491	103 0
		Co Rd, N	Wed	6/26	8A–Noon	52	25 1	207	103 9	199	254	78 3
24–11	North edge of Schleswig	#59	Mon	6/24	1–5 P M	87	32 6	267	103 9	257	368	69 8
75–6	Intersection #5, #140 & Co Rd, 2 Mi E of Remsen	#5 E	Wed	6/26	1–5 P M	213	32 6	654	103 9	630	868	72 7
		#5 W	Wed	6/26	1–5 P M	258	32 6	791	103 9	762	1090	69 9
		#140 S	Wed	6/26	1–5 P M	55	32 6	169	103 9	163	271	60 2
		Co Rd, N	Wed	6/26	1–5 P M	12	32 6	37	103 9	36	75	48 0
81–7	Junction #20 & Twp Road, W edge of Schaller	#20 N	Mon	6/24	8A–Noon	173	25 1	689	103 9			
					1–5 P M	124	32 6	380	103 9			
						Average		535	103 9	515	599	86 0
		#20 E	Mon	6/24	8A–Noon	213	25 1	848	103 9			
					1–5 P M	154	32 6	474	103 9			
						Average		661	103 9	636	747	85 1
		Twp Rd South	Mon.	6/24	8A–Noon	42	25 1	167	103 9			
					1–5 P M	32	32 6	98	103 9			
						Average		133	103 9	128	212	60 4
81–14	Intersection #4, #35 & Twp Rd, 1 Mile W of Odebolt	#35 W	Mon	6/24	8A–Noon	97	25 1	386	103 9	372	485	76 7
		#4 S	Mon	6/24	8A–Noon	88	25 1	350	103 9	337	324	104 0
		#4 & 35, E	Mon	6/24	8A–Noon	192	25 1	765	103 9	737	815	90 4
		Twp Rd North	Mon	6/24	8A–Noon	21	25 1	84	103 9	81	126	64 3

adjustment by use of master station factors

The flow map produced as the result of the adjustment of data from stations widely dispersed both with respect to time and space appears to be quite consistent in its presentation of the volume and classification of traffic on each section of the primary road system In the counting, each county was operated as a unit The schedule of station operation only rarely gave the opportunity for counts on adjoining sections of the road at the same time. As only about 100

TABLE IX

COMPARISON OF TRAFFIC COUNTS IN STORY COUNTY AT VARIOUS SEASONS TO THE MASTER STATION COUNT

(Average Week Day Traffic)

Station Number	Location of Station	Roadway	Season of Count	Date and Time Counted			Total 24-Hour Traffic	Per Cent of Master Station	Total 24-Hour Traffic Calculated to Week of 3/25/35	Per Cent Recount of Winter Count as of Week of 3/25/35
				Week Beginning	No of Days	Hrs				
85–1	Intersection of #30 and County Road, 1 Mile West of Ames	#30 East	Winter	1/28/35	10	24	1366	56 2	1857	
			Fall	10/21/35	3	8	1832	61 4	2031	109 4
		#30 West	Winter	1/28/35	10	24	1177	48 4	1600	
			Fall	10/21/35	3	8	1650	55 4	1829	110 8
		Co Rd North	Winter	1/28/35	10	24	176	7 2	239	
			Fall	10/21/35	3	8	161	5 4	178	74 5
		Co Rd South	Winter	1/28/35	10	24	106	4 4	144	
			Fall	10/21/35	3	8	129	4 3	143	99 3
85–2	E Edge of Ames	#30	Winter	12/24/34	10	24	2364	95 2	3140	
			Fall	10/21/35	5	8	2930	98 4	3248	103 4
85–12	N Edge of Huxley	#65	Winter	2/11/35	5	12	2470	93 2	3075	
			Fall	10/21/35	5	8	2640	88 7	2927	95 2
85–18	Junction of #69 & #115, West of Story City	#69 North	Winter	1/14/35	5	12	788	42 7	1409	
			Winter Recount	3/11/35	5	12	1372	44 4	1465	104 0
			Fall	10/21/35	5	8	1386	46 5	1537	109 1
		#69 South	Winter	1/14/35	5	12	877	47 6	1570	
			Winter Recount	3/11/35	5	12	1470	47 6	1570	100 0
			Fall	10/21/35	5	8	1500	50 3	1663	105 9
		#115 East	Winter	1/14/35	5	12	626	34 0	1120	
			Winter Recount	3/11/35	5	12	1053	34 1	1125	100 4
			Fall	10/21/35	5	8	906	30 4	1004	89 6
Total (Winter—First Count)									14154	
Total (Fall—Recount)									14560	102 9

stations were operated at any one time, a period of about 16 weeks was required to complete the survey Thus, a station operated for at least 14 weeks at different sites, and for two weeks at one site within the county

The consistency of the traffic pattern appears to permit its use for shorter counts than those of the past survey It has been demonstrated that reliable results may be obtained in at least two city surveys recently made in Iowa the stations on the system, insofar as composition, variation in flow and responsiveness to seasonal influence are concerned

STATISTICAL ANALYSIS

Further use of the master station data has been indicated from the results of a statistical analysis of various methods of sampling the traffic flow The data derived in these studies are shown in Tables X and XI

TABLE X

STATISTICAL ANALYSIS OF MASTER STATION DATA COMPARING ACCURACIES OF METHODS OF SAMPLING

Number of Days Represented in Sample	Hours Counted per Day	Total Hours in Sample	Time of Day Represented in Sample	Number of Samples to Use Up Entire Year	Average Week Day 24-Hour Traffic			Range of Variation in Sample (Ave)	Standard Deviation Between Samples	Coefficient of Variation (Per Cent)	Per Cent of True Mean		
					Mean of All Samples (Ave)	High Sample (Ave)	Low Sample (Ave)				Deviation of All Samples	High Value	Low Value
12	24	288	Whole	22	3031	3427	2854	573	148	4 9	0 000	113	94
12	8	96	8A–12A 1P– 5P	22	3029	3367	2645	722	172	5 7	0 066	111	87
12	4	48	8A–12A	22	3026	3408	2592	816	176	5 8	0 165	112	85
12	4	48	1P– 5P	22	3032	3431	2693	738	152	5 0	0 033	113	89
12	1	12	7A– 7P	264	3042	3664	2636	1028	175	5 6	0 363	121	87
24	1	24	7A– 7P	132	3042	3484	2774	710	125	4 1	0 363	115	91
24	2	48	7A– 7P	66	3042	3371	2824	547	106	3 5	0 363	111	93
264	1	264	7A– 7P	12	3042	3097	2990	107	40	1 3	0 363	102	99

Counts of one to four hours were found reliable if, at some place in the survey territory, a 12 or 24-hour count was used for a few days to determine the daily traffic pattern

The use of any master station data depends upon the similarity of traffic patterns, traffic composition, and traffic habits It appears that for conditions as they are found in Iowa, in which the population, the principal industries, and the road systems are all uniformly distributed, a single master station may obtain data typical of the majority of

Eight different methods of sampling were used For the methods using four hours or more per day there was little difference in accuracy of the mean of all samples taken Individual samples gave values within a range of plus or minus 13 per cent of the true mean Samples using one and two hour counts, gave slightly greater range, a value of 21 per cent above, and 13 per cent below the true mean for one method The remainder of the short, or one and two hour counts, were of the same order of accuracy as the 4, 8, and 24-hour counts

Of course, considerable credit for the accuracy of the short count samples must be given to the daily traffic pattern used to convert them to full day counts The daily traffic pattern, once determined and occasionally checked, becomes therefore one of the most valuable traffic characteristics for use in an extensive survey

The data in Table XI indicate the accuracy that may be expected for even shorter counts These form a series of one hour counts on each of twelve days, uniformly distributed throughout the year Each member of the series began with a different hour of the 12-hour day, and each sample of each group began with a different hour of the day, advancing to the succeeding hour each successive day About the same accuracy was obtained as for the series reported in Table X The results indicate most decisively that once the daily traffic pattern is known quite accurately, short counts may be made with a high degree of accuracy

CONCLUSIONS

From the data obtained in this survey and presented and discussed in this report definite conclusions may be drawn It appears that·

1 The stream of traffic passing the master station is typical of the traffic on the major portion of the primary road system of Iowa insofar as composition and habits of movement are concerned

2 The effects on the volume and composition of the traffic passing this station of such influences as the hour of the day, the day of the week, the month of the year, condition of the roadway, and state of the weather, were found to be definite and measurable

3 The effects on the volume and composition of the traffic at the master station of the influences referred to above were found to be similar and propor-

TABLE XI

STATISTICAL ANALYSIS OF MASTER STATION DATA SHOWING ACCURACIES OF SHORT COUNTS

Number of Days Represented in Sample	Hours Counted per Day	Total Hours in Sample	Time of Day Represented in Sample	Number of Samples in Each Group	Average Week Day 24-Hour Traffic			Range of Variation in Sample (Ave)	Standard Deviation Between Samples	Coefficient of Variation (Per Cent)	Per Cent of True Mean		
					Mean of All Samples (Ave)	High Sample (Ave)	Low Sample (Ave)				Deviation of All Samples	High Value	Low Value
12	1	12	7A–7P	22	3048	3608	2703	905	213	7 0	0 561	119	89
12	1	12	7A–7P	22	3083	3436	2724	712	206	6 7	1 716	113	90
12	1	12	7A–7P	22	3097	3551	2671	880	137	4 4	2 178	117	88
12	1	12	7A–7P	22	3049	3543	2660	883	201	6 6	0 593	117	88
12	1	12	7A–7P	22	3022	3457	2658	799	37	1 2	0 297	114	88
12	1	12	7A–7P	22	2990	3472	2640	832	170	5 7	1 352	115	87
12	1	12	7A–7P	22	3005	3468	2636	832	182	6 1	0 857	114	87
12	1	12	7A–7P	22	3043	3314	2670	644	179	5 9	0 396	109	88
12	1	12	7A–7P	22	3050	3473	2644	829	238	7 8	0 626	115	87
12	1	12	7A–7P	22	3036	3456	2699	757	257	8 5	0 165	114	89
12	1	12	7A–7P	22	3036	3459	2700	759	191	6 3	0 165	114	89
12	1	12	7A–7P	22	3045	3535	2700	835	283	9 3	0 462	117	89

tional to that on the traffic upon each section of the primary road system

4 The data obtained at the master station permit the derivation of traffic flow characteristic factors for the relative volumes of traffic flowing hourly, daily, weekly, monthly, and annually at any observation station at which the traffic is similar in composition and habits of movement to that passing the master station

5 The factors derivable from master station data, representative of similar traffic data at other stations, may be used for the computation, correlation and coordination of counts made at these stations during different periods within the period of operation of the master station

6 The factors derivable from the master station data may be used for the adjustment of a brief series of short counts, from one to twelve hours in length, to full or continuous count basis, if the short counts be uniformly distributed throughout the year

7 The factors derivable from the master station data permit the conduction of a traffic survey composed of a brief series of short counts for a large number of stations during the year period at but a small fraction of the cost of full or continuous counts at these stations, thus making it possible to extend greatly the coverage of traffic counts while keeping the cost within due bounds It is also a means of maintaining frequent checks on roads previously studied for detecting changes in volume or composition of traffic without extensive observations