

Effect of Street Lighting on Night Traffic Accident Rate

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● IN many large cities throughout the country, studies have been made to determine what effect the illumination of a roadway has upon the nighttime accident rate. The task is quite difficult under normal circumstances because of the presence of other variable factors which also influence the nighttime accident rate. However, by careful analysis of traffic accident records, it is possible to show that accident rates at night are decreased as a result of improved lighting conditions or, in other words, higher levels of illumination.

By examination of traffic accident reports received from the Traffic Section of the Chicago Park District, it is possible to show graphically the value and importance of higher levels of street lighting in reducing the nighttime accident rate. Examination of Figure 1 shows that on Michigan Boulevard between the river and 12th Street where the average lighting level was 0.144 foot-candles, the night accident rate per million miles of travel for all accidents is 17.9. Between 12th and 16th where the light level was 0.350 foot-candles, the accident rate is 11.9, and in the section from 16th Street to 22nd Street which has an average lighting level of 0.88 foot-candles, the accident rate is 9.5. Therefore, a definite tendency to reduce the nighttime accident rate by increasing the average lighting level is observed. This is a boulevard on which the various sections fall in the same general classification in relation to vehicle miles traveled; that is, having more than 10 million vehicle miles of travel per year. The type of lighting installation which existed in 1949 on each of the sections mentioned is listed below:

MICHIGAN BOULEVARD

Each Fixture - SECTION: River to 12th Street - 6-1,000 lumen incandescent lamps
12th to 16th Street - 10,000 lumen incandescent lamps
16th to 22nd Street - 20,000 lumen mercury vapor lamps

NIGHTTIME ACCIDENTS PER MILLION VEHICLE MILES TRAVELED ON SECTIONS OF MICHIGAN AVENUE

From September 1st, 1948, through August 31st, 1949

	MVM	Light Level ¹	Accidents				Accidents Per MVH			
			F	NF	PD	T	F	NF	PD	T
River to 12th St.	9.27	0.144	1	34	131	166	.1	3.7	14.2	17.9
12th to 16th	2.44	0.352	0	14	15	29	0	5.7	6.1	11.9
16th to 22nd	1.89	0.880	0	6	12	18	0	3.2	6.3	9.5

SYMBOLS

MVM	Million Vehicle Miles	P.D	Property Damage
F	Fatal Accidents	T	Total
NF	Non-Fatal Accidents	¹	Foot-candles

The diagram shown on Figure 2 indicates the fatal and non-fatal night accidents that were saved as a result of improved lighting. Accident data were obtained for a particular section of Michigan Boulevard and a comparison was made of accidents which occurred before relighting (1947) and after relighting (1949). The daytime accident rate for 1949 was approximately 100 percent greater than that for 1947, as a result of the increase in traffic volume. The main factors which would cause a variation of the nighttime accident rate are traffic volume and level of illumination.

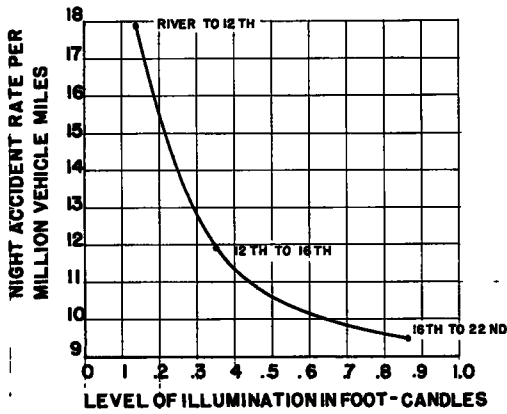


Figure 1. Trend in nighttime accident rate under various levels of illumination for one year ending August 31st, 1949, Michigan Boulevard.

age accidents in 1949 would have been increased by the same proportion of increase that occurred in daytime property damage accidents. Although the graph shows an increase in night accidents for 1949, the increase is, nevertheless, considerably lower than the expectancy. By the prediction made, the expectancy would be 17.0 property damage accidents per million vehicle miles. The actual rate from traffic records was 6.96. Therefore, the savings as a result of increased illumination is found to be approximately 61 percent.

Examination of the overall or total night and day accident rates for two adjacent sections of Michigan Boulevard which were re-lighted, reveals the following:

Section	Accident Rates Per Million Vehicle Miles		
		Daylight	Dark
12th to 16th St.	1947	3.6	9.8
	1949	9.4	7.3
16th to 22nd St.	1947	4.84	12.74
	1949	12.80	9.45

The expectancy of nighttime accidents for 1949, applying the same prediction made previously, would:

12th to 16th Street:

Ratio of daylight increase (1949 to 1947)	$\frac{9.4}{3.6} = 2.6$
Expectancy of nighttime accidents, 1949 is	$9.8 \times 2.6 = 25.5$
Actual rate for 1949 was	7.3
Percent saving as a result of improved lighting was	$\frac{25.5 - 7.3}{25.5} = 71.5\%$

16th to 22nd Street:

A 19-year record for all boulevards and drives of the Chicago Park District shows that the increase in traffic volume at night results in an increase of the night accident rate in the same proportion as the day rate.

Prediction of future accidents based on this correlation shows that the nighttime accident rate for 1949, without improved lighting, would have been approximately 13.3. Traffic records reveal that the night rate for 1949 was actually 2.49. Therefore, as a result of improved lighting, an 81 percent saving in fatal and non-fatal accidents was realized.

Figure 3 illustrates the savings in nighttime property damage accidents which may be accredited to improved lighting. The same prediction made for Figure 2 applies; that is, without improved lighting the night accident rate for property damage

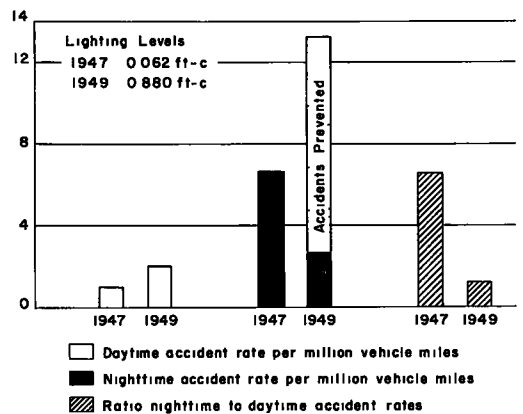


Figure 2. Effect of improved lighting upon fatal and non-fatal accidents. Michigan Blvd., 16th to 22nd.

ACCIDENTS

	DAYLIGHT				DARK			
	F	NF	PD	T	F	NF	PD	T
Before (1947)	0	4	15	19	0	12	11	23
After (1949)	0	9	47	56	0	5	14	19

ACCIDENT RATE PER MILLION VEHICLE MILES

	DAYLIGHT				DARK					
	MVM	F	NF	PD	T	MVM	F	NF	PD	T
Before (1947)	3.93	0	1.02	3.82	4.84	1.80	0	6.65	6.09	12.74
After (1949)	4.38	0	2.06	10.74	12.80	2.01	0	2.49	6.96	9.45

RATIO DARK TO DAYLIGHT PER MILLION VEHICLE MILES

	Fatal and Non-Fatal	Property Damage	Total
Before(1947)	6.51	1.59	2.63
After(1949)	1.20	0.65	0.74
Ratio of daylight increase (1949 to 1947)		$\frac{12.80}{4.84} =$	2.64
Expectancy of nighttime accidents, 1949 is		$12.74 \times 2.64 =$	33.6
Actual rate for 1949 was		9.45	
Percent saving as a result of improved lighting was...		$\frac{33.6 - 9.45}{33.6} =$	71.7%

A visual picture of the above results can be obtained by a study of Figure 4.

Cost of Relighting Chicago Park District Boulevards Compared to Savings Resulting from a Reduction in Nighttime Accident Rate

Costs set up by the National Safety Council released July 1954:

Each death	\$22,600
Each non-fatal injury	1,250
Each property damage accident	190

Accident data obtained from Traffic Section of the Chicago Park District for the year 1949 for all boulevards.

Fatal	40
Non-fatal	1290
Property damage	4365

The cost of relighting the Chicago Park District boulevards is indicated by a recently completed typical installation on which the costs were as follows:

Cost of Modernizing Lighting to Conform to I. E. S. Standards (American Standard Practice for Street and Highway Lighting)

PER LAMPOST	Material	Labor	Total
	Lamppost complete, including luminaire, lamp and ballast	\$260	\$110

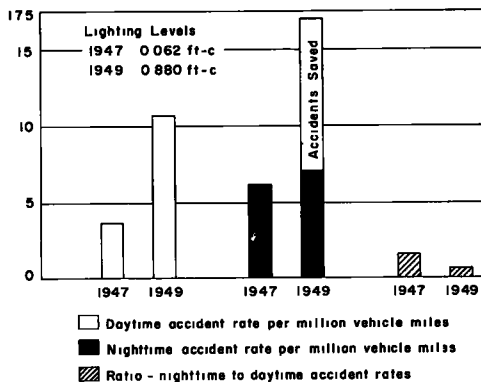


Figure 3. Effect of improved lighting upon property damage accidents. Michigan Blvd. 16th to 22nd.

	Material	Labor	Total
Lamppost foundation	22	80	102
Total - per lamppost	\$282	\$190	\$472
PER MILE			
	Material	Labor	Total
Lampposts complete, including luminaire, lamp and ballast	\$13,520	\$5,720	\$19,240
Lamppost foundations	1,144	4,160	5,304
Total - Lampposts, per mile	\$14,664	\$9,880	\$24,544
On older boulevards considerable rebuilding of underground system was necessary			\$18,156
New cable and rearrangement of existing cables	3,228	4,956	8,154
Total, Per Mile			\$50,884

For the following calculations we have used a round figure of \$50,000 per mile.

Cost of Nighttime Accidents

Fatal	40 at	\$22,600 =	\$ 904,000
Non-Fatal	1290 "	1,250 =	1,612,500
Property Damage	4365 "	190 =	829,350
Total cost -			\$3,345,850

Assuming, from results obtained in previous calculations, that approximately 70 percent of the nighttime accidents could be eliminated by improved lighting:

Possible annual saving—70 percent of \$3,345,850 = \$2,342,095.

Cost of Relighting 205 Miles of Park District Boulevards

Average cost of \$50,000 per mile multiplied by 205 miles—\$10,250,000.

$$\text{Span of Program} = \frac{\$10,250,000}{\$2,342,095} = 4.38$$

Therefore, in a period of less than five years, the complete cost of relighting all boulevards would be balanced by the savings in nighttime accidents.

The elimination of this menace to night driving and the essential planning of an extensive program of street relighting is a responsibility resting upon every citizen and all who are working in the best interests of the general public.

Table 1 shows the day and nighttime accident rate per million vehicle miles for the interim of 1936 to 1954, inclusive. It should be noted that there was a marked decrease in both the day and night accident rate during the war years, 1942 to 1945 inclusive, when highway speeds were limited to 35 miles per hour. It should also be noted that there has been a gradual reduction in the nighttime accident rates since 1950, at which time the effect of improved street lighting on the Park District

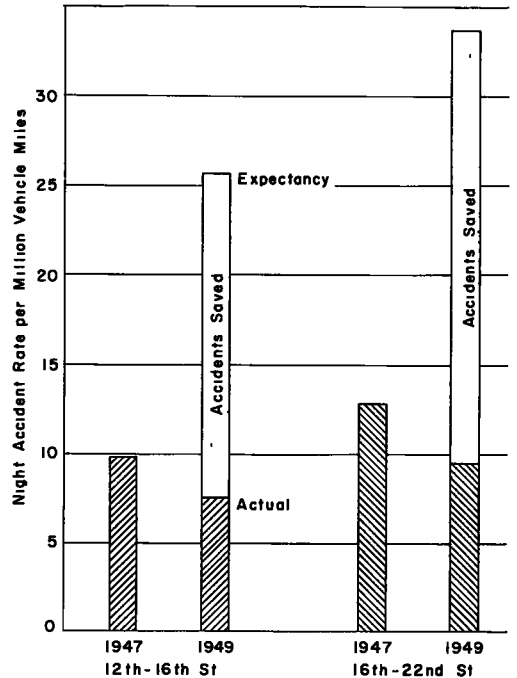


Figure 4. Effect of improved lighting upon total nighttime accidents, Michigan Blvd.

TABLE 1. — Chicago Park District, all Boulevards and Drives, Accident Rates and Vehicle Miles Traveled.

Year	DAYLIGHT										DARK										RATIO OF DAYLIGHT TO DARK TO			
	Millions of Vehicle Miles		Accidents			Accidents Per Million Veh Miles					Millions of Vehicle Miles		Accidents			Accidents Per Million Veh. Miles				F	NF	PD	T	
	F	NF	PD	T	F	NF	PD	T	F	NF	PD	T	F	NF	PD	T	F	NF	PD	T				
1936	643			4098					6 87	2 89						3 82				11 70				
1937	702			5283					7 53	3 16						4 88				13 89				
1938	704			4449					6 32	3 17						4 12				13 00				
1939	718			5541					7 72	3 23						4 84				14 98				
1940	764 3	28	1483	4480	5991	0 04	1 94	5 86	7 84	343 4	62	1757	3520	5839	0 18	5 12	10 25	15 55	4 50	2 64	1 75	1 98		
1941	814 4	27	1588	4996	6611	0 03	1 95	6 14	8 12	365 9	69	1839	3728	5636	0 19	5 02	10 19	15 40	6 33	2 57	1 66	1 90		
1942	856 6	14	1175	3242	4481	0 02	1 79	4 94	6 75	295 0	47	1295	2600	3942	0 16	4 39	8 81	13 86	8 00	2 45	1 78	1 98		
1943	516 8	17	821	1883	2721	0 03	1 59	3 64	5 26	232 2	44	906	1569	2519	0 19	3 90	6 76	10 85	6 38	2 45	1 86	2 06		
1944	518 7	17	814	1982	2811	0 03	1 57	3 82	5 42	233 0	47	969	1587	2553	0 20	4 16	6 60	10 96	6 67	2 65	1 73	2 02		
1945	363 8	24	958	2142	3124	0 04	1 70	3 80	5 54	253 3	46	1095	1913	3084	0 18	4 32	7 55	12 05	4 50	2 54	1 99	2 18		
1946	727 7	12	1244	3524	4780	0 02	1 71	4 84	6 57	326 9	66	1436	2863	4355	0 20	4 36	8 76	13 22	10 00	2 55	1 81	2 03		
1947	803 2	26	1225	3982	5313	0 03	1 65	4 93	6 61	360 8	42	1531	3239	4892	0 12	4 18	8 93	13 43	4 00	2 05	1 82	2 04		
1948	843 3	11	1374	4909	6294	0 02	1 68	5 82	7 47	378 9	47	1400	3818	5265	0 13	3 69	10 08	13 90	6 50	2 26	1 73	1 86		
1949	893 6	15	1347	5852	7214	0 02	1 50	6 55	8 07	401 5	46	1878	4719	6143	0 12	3 48	11 75	15 30	6 00	2 29	1 79	1 90		
1950	953 2	11	1486	7261	8758	0 01	1 56	7 62	9 19	428 2	44	1610	6118	7772	0 10	3 76	14 29	18 15	10 00	2 41	1 88	1 97		
1951	971 0	19	1488	7528	9035	0 02	1 53	7 75	9 30	436 3	38	1511	6090	7639	0 09	3 46	13 96	12 51	4 60	2 26	1 80	1 88		
1952	976 7	23	1592	7155	8770	0 02	1 63	7 75	8 98	438 8	39	1409	5091	6539	0 09	3 21	11 60	14 90	4 50	1 97	1 58	1 66		
1953	996 7	11	1703	7230	8944	0 01	1 71	7 25	8 97	447 8	35	1462	5224	6721	0 08	3 26	11 67	15 01	8 00	1 91	1 61	1 87		
1954	1024 4	22	1868	7419	9303	0 02	1 12	7 24	9 08	480 3	38	1469	4705	6212	0 08	3 19	10 22	18 49	4 00	1 75	1 41	1 49		

Code F—Fatal, NF—Non Fatal, PD—Property Damage, T—Total

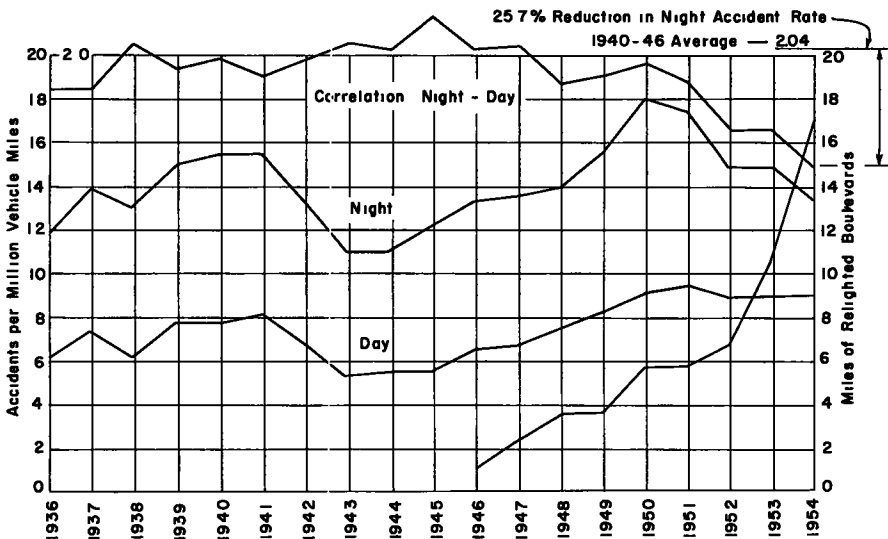


Figure 5. Accident rates for all Chicago Park District Boulevards and Drives.

boulevards began to show results. As the lighting on more park boulevards is improved, it is anticipated that there will be a continuing reduction in the night accident rate.

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