HIGHWAY PLANNING METHODS OF THE MICHIGAN STATE HIGHWAY DEPARTMENT

Thesis for the Degree of B. S.
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Earl O. Bengry

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Highway Planning Methods of the

Michigan State Highway Department

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by

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CHAPTER I

INTRODUCTORY

I. RESULTS OF PREVIOUS WORK

Highway construction and planning first began to be a problem about the year 1915. From that time forward the sensational growth of motor transportation made necessary the construction of the vast highway systems in existence today. Our present highway system is the result of previous work in highway planning, although, as compared with present problems, there was not a great deal involved in the planning. Needs were everywhere and obvious. The first step was naturally the construction of all-weather roads between major cities, and the next need was for a secondary or local system for providing means of transportation among various sections of smaller areas. Finally, it was necessary to knit the system together in such a manner so as to facilitate transportation between various sections of the state and nation as a whole. This work was of course all done after the volume of traffic and the number of vehicles in operation made it necessary.

II. NEED FOR IMPROVED METHODS

Inasmuch as highway construction came after demands, our highway system has never been completely adequate or up to date. In order to achieve an adequate system, it is necessary to plan a good many years into the future so that new construction will not be obsolete and inadequate before the expiration of its economic life. Accomplishment of this demands some knowledge of the type of performance to be expected of the highways that will be in use, say, twenty years hence, and also a knowledge of the traffic volume and distribution which must be accommodated.

It is the purpose of this paper to present in a general way the methods being experimented with at present by the Michigan State Highway Department in conjunction with a nation-wide highway planning survey by the Public Roads Administration.

CHAPTER II

THE INVESTIGATION

I. PHYSICAL INVENTORY OF ROADS AND STREETS

In order to determine what additions and improvements must be made on the present system to make it adequate for known present traffic or anticipated future traffic, it is necessary to know exactly what is on hand in the line of highways and streets. Since there were so many independent agencies engaged in the construction of what constitutes our present system, there was little or no accurate record kept of the total work done. Therefore, the first step in the proposed planning program was to take a complete physical inventory of every mile of road surface in the state. The following pertinent information was collected.

Location. All highways of the state trunk line system were divided into small units known as sub-sections and the location of each sub-section determined. That is, with reference to its position in the system, the points which are considered its terminals, and the county in which it is found.

Length. The length of each sub-section, to the nearest one-hundredth of a mile, was determined by scaling from maps in the records of the State, County, and Local Highway Departments or else by speedometer measurements where no records were available.

Surface. The highway surface of each sub-section was carefully appraised, noting the type of surface, its present condition, its width, and also its present age and defects.

Alinement. Horizontal and Vertical alinement were appraised on the basis of the number and lengths of all curves with a degree of curvature greater than 6 15 , and the number and lengths of all grades steeper than 5%.

Structures. Bridges and railroad or highway grade separations were counted and their respective spans measured on each sub-section of highway. Other information obtained for each structure included roadway width, horizontal and vertical clearance, type of construction, material used, load limit, and present age.

Railroad crossings. The number of places where railroads crossed highways at grade was also noted for each sub-section.

Economic and social factors. This item included location and number of all farms, residences, schools, churches, business establishments, industries, institutions, recreational facilities, and railroad stations bordering each sub-section of highway.

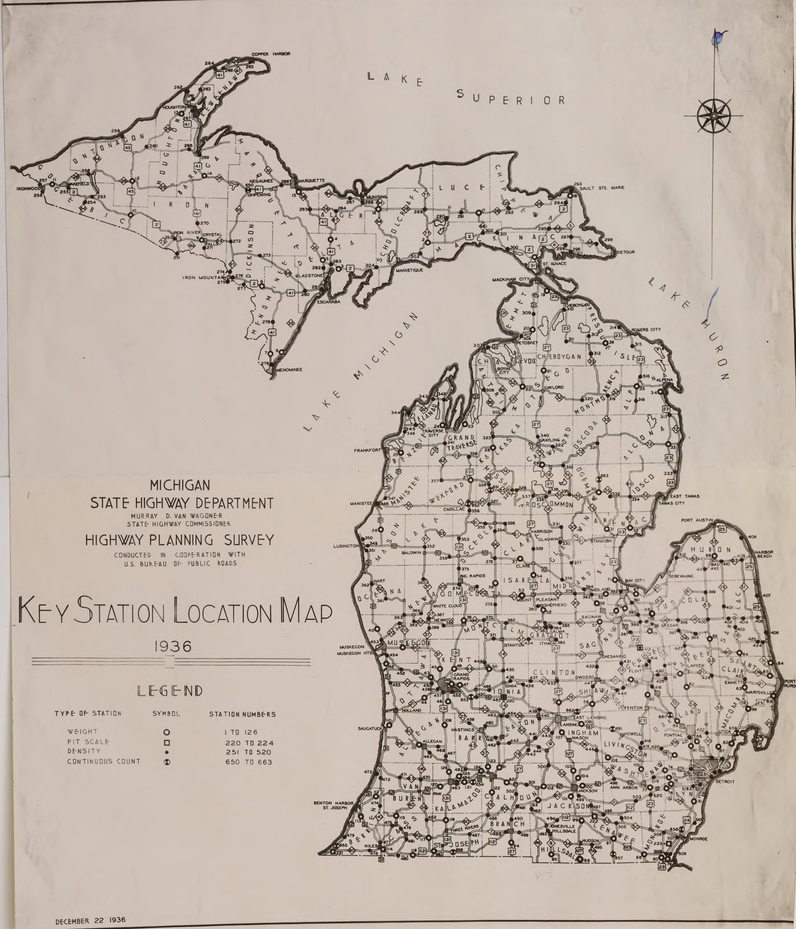
II. MAPPING OF THE PRESENT SYSTEM

After gathering all the above-listed data on the present highway system it was necessary to plot the locations on a series of maps so as to present a large part of this information in a readily understandable and usable form. This was done and resulted in a series of large scale maps for each county of the state showing all roads, surface types, widths, railroads, rivers, lakes, and considerable other social and commercial detail related to highway valuation and location.

III. TRAFFIC SURVEY

A complete traffic survey was made of all state trunk line highways during 1936, according to the following method. Figure 1, page 6, is a map of Michigan showing location of all principle traffic count stations and their types.

Key stations. Traffic was counted at 331 key stations located at trunk line - trunk line junctions and trunk - line - county road junctions for a six-hour period of each day throughout the year. The six-hour periods were rotated at 26-day intervals. That is , the traffic was counted from 6:00 A.M. to 12:00 noon for the first 26 days, from 12:00 noon to 6:00 P.M. for the second 26 days, from 6:00 P.M. to 12:00 midnight for the third 26 days, and from 12:00 midnight to 6;00 A.M. for the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STATE HIGHWAY COMMISSIONER
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
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KEY STATION LOCATION MAP
1936
LEGEND
TYPE OF STATION
SYMBOL
STATION NUMBERS
WEIGHT
1 TO 126
PIT SCALE
220 TO 224
DENSITY
251 TO 520
CONTINUOUS COUNT
650 TO 663
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
DECEMBER 22 1936

fourth 26-day period. The fifth 26-day period went back to the 6:00 A.M. to 12:00 noon interval and the cycle was repeated throughout the year.

There were two different types of these key stations, classed according to the data collected. There were 131 weight stations which collected data on weights of vehicles as well as numbers and density of vehicles passing. Of the 131 weight stations, 126 were of the loadometer type and 5 were of the pit-scale type. The remaining 250 key stations were what are called density stations and merely counted traffic.

Continuous count stations. There were 14 of these stations operated 24 hours per day, every day of the year. They were placed on routes known to be more heavily traveled than others.

Blanket count stations. During the three summer months, June, July, and August, traffic was counted during the 8-hour period from 8:00 A.M. to 4:00 P.M. on one or two different days at 12,228 different stations. These stations gave sample data on traffic for each two-mile section of road.

Capacities of highways. In most of its work the Michigan State Highway Department uses traffic capacities of various types of highways in terms of the number of vehicles the highway is capable of carrying per hour.

This has been found to be a more dependable criterion of highway adequacy than capacity given in terms of the number of vehicles the highway is capable of carrying per day because many highways carry a very large portion of their traffic during one or two relatively short peak periods of the day, with correspondingly higher traffic volumes for the peak hours during the heavier traffic seasons of the year. Thus, the traffic at peak periods is more the condition to be designed for than the number of vehicles carried per day.

From past experience and from comparison with similar results obtained in other states, the following highway capacities have been used by the Michigan State Highway Department:

Number of lanes	Capacity in vehicles per hour
Two	400
Three	800
Four	1,200
Four (Divided)	2,000

Data conversion. Since highway capacities will be used in terms of the number of vehicles they are capable of carrying per hour, the traffic survey figures had to be reduced to similar terms. The figure decided upon was the average hourly traffic for the 100 highest hours during the year. This figure then is the chief criterion of adequacy and the basis of design since it relates to traffic at peak periods. It was found for each sub-section of highway by totaling the hourly traffic for the

100 highest hours and dividing by 100. This figure is very important as it is the basis of nearly all the planning procedure.

Future traffic. It is expected that the automobile will continue to grow, both in numbers and intensity of use. The basis of this assumption lies in the belief that the following factors tend to promote the growth of traffic: (a) improved design, bringing about lower cost of operation, (b) continued growth of the driving habit, (c) generally rising social and economic standards of living, and (d) general increase in available liesure time among the population as a whole.

Estimates arrived at independently by highway engineers, economists, and research engineers of the automotive industry agree in placing the number of vehicles that will be in operation in 1960 at one-third more than the number in operation in 1936. It is also estimated that the number of vehicle-miles traveled in Michigan in 1960 will be twice the 1936 total of 10½ billion vehicle-miles.

Traffic maps. Figures obtained in the traffic survey were compiled and plotted on a series of traffic maps in order to show more clearly and comprehensively the flow of traffic on highways throughout the state. There were six different maps produced from the data, one to show each of the following traffic figures: (a) average daily traffic flow, (b) maximum daily traffic flow, (c) commercial traffic flow, (d) bus traffic flow, (e) foreign traffic flow, and (e) average daily traffic volume per lane. Figures 2, 3, and 4 on pages 11, 12, and 13 are copies of the maps showing average daily traffic flow, maximum daily traffic flow, and average daily traffic volume per lane, respectively.

IV. COMPILATION OF DATA

To facilitate the grouping and drawing off of data collected by the field inventory and the traffic survey, a method was worked out whereby machine tabulating equipment could be used.

Posting tabulating sheets. Tabulating sheets were designed for posting data from the road inventory and the traffic survey. Figure 5 on page 14 is a sample of the form used. As will be seen, columns are provided for the various items of information obtained. Each sub-section of highway occupies one line of the sheet, and the facts gathered for that particular sub-section are entered into proper columns. The first group of columns identifies the sub-section, giving its location, the number of the highway of which it is a part, and also its length. Next is a group of columns for information about the surface, including width, type, condition, and defects. The next group of columns is used to record the number of farms, residences, schools, churches, industries, etc., which border on the

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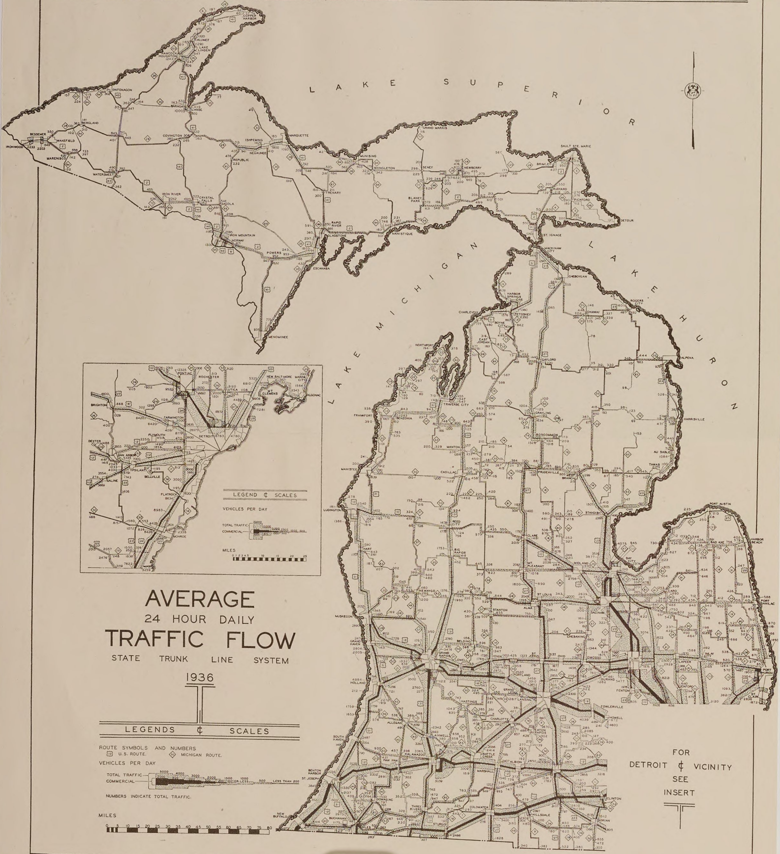
HIGHWAY TRAFFIC



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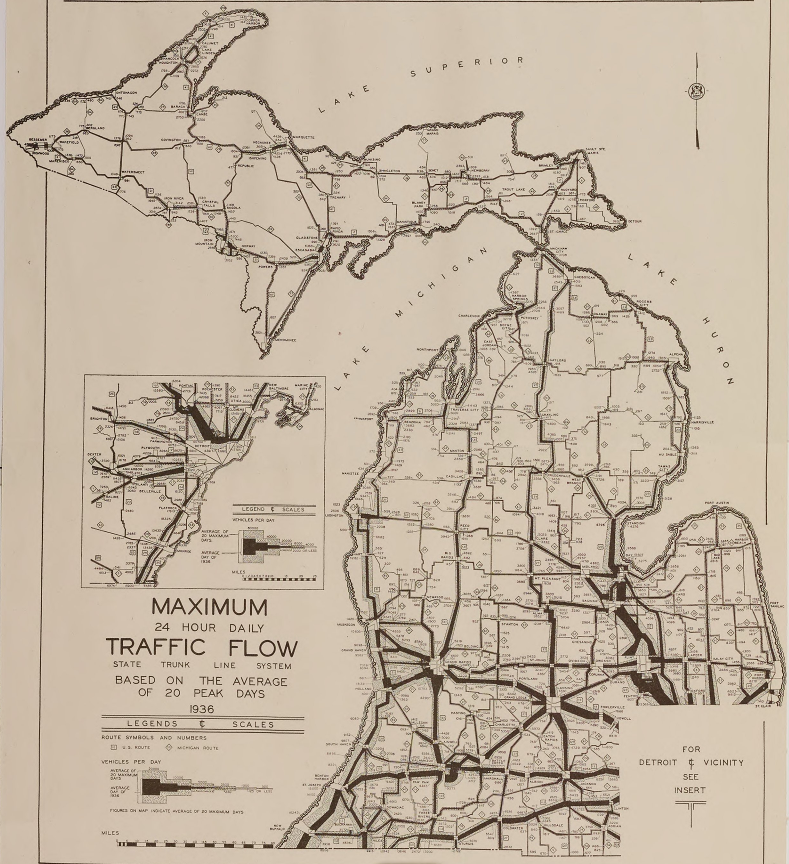

Fig. 4 Average Daily Traffic Volume Per Lane

R.I. 1

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ROAD INVENTORY — GENERAL SUMMARY

SHEET ____________

COUNTY ____________

TOWNSHIP ____________

LINE NUMBER	IDENTIFICATION NUMBER	SYSTEM	ROAD NUMBER	SECTION NUMBER	SECTION LENGTH (MILES)		GRADED WIDTH	SURFACE WIDTH	SURFACE TYPE	SURFACE CONDITION	SURFACE DEFECTS	CULVERTS	FARMS F-1	FARMS F-2	DWELLINGS YEAR AROUND	DWELLINGS SEASONAL	BUSINESS ESTABLISHMENTS	SCHOOLS	INDUSTRIES	CHURCHES	INSTITUTIONS	RECREATIONAL	R. R. STATIONS	GRADES 5.1% TO 8% NUMBER	GRADES 5.1% TO 8% LENGTH (MILES)		GRADES OVER 8% NUMBER	GRADES OVER 8% LENGTH (MILES)		CURVES 6°15' TO 11° NUMBER	CURVES 6°15' TO 11° LENGTH (MILES)		CURVES OVER 11° NUMBER	CURVES OVER 11° LENGTH (MILES)		RESTRICTED SIGHT NUMBER LESS THAN 500 (FT.)	RESTRICTED SIGHT NUMBER 501 TO 1000 (FT.)	RESTRICTED SIGHT NUMBER 1001 TO 1500 (FT.)	SIDEWALKS SINGLE (MILES)	SIDEWALKS DOUBLE (MILES)	AVERAGE DAILY TRAFFIC
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4																																									
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42

sub-section. Information on vertical and horizontal alinement, the number of restricted sights, and the number of miles of sidewalks was posted to the next group of columns. The last column records the average daily traffic on the sub-section.

Coding. Next a code system was designed to permit conveying the information on the tabulating sheets to tabulating cards by punching out the proper combination of numbers in the respective columns. This made it possible to use machines for sorting and arranging data.

Preparation of tabulating cards. Figures 6 and 7, on page 16 are samples of the tabulating cards used. Following the coding system previously designed, one card was punched for each line of the tabulation sheet, thereby transferring the data in code for a single sub-section of highway to the tabulating card.

Tabulations drawn off. The purpose of using machine tabulating equipment was to speed up the work of sorting the pertinent items of the unwieldly mass of data obtained in the road inventory and traffic survey.

By running all the cards through the machine it was possible to sort out any desired group of data. The following are a few of the tabulations that were necessary: (a) a list of all sub-sections carrying traffic in excess of their rated capacity, (b) separation of the

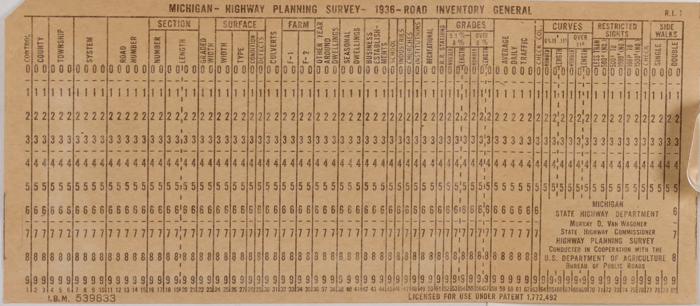

Fig. 6 Tabulating Card

Road Inventory General

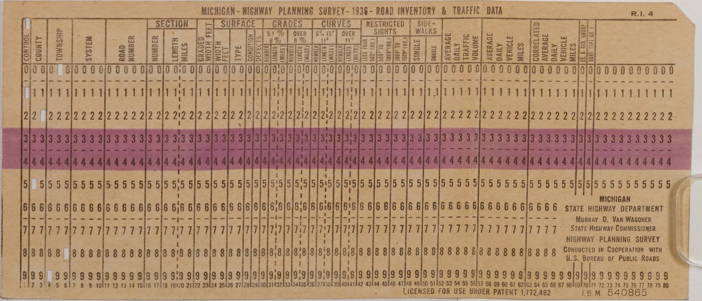

Fig. 7 Tabulating Card

above tabulation into the respective surface groups, (c) a list of all narrow pavements less than 20 feet wide, (d) a list of all sections with badly worn or defective surfaces. More will be said of these tabulations and their use by planning engineers under the paragraph labeled Highway improvement priorities on page 21.

CHAPTER III

I. IMMEDIATE PLANNING PROGRAM

Available funds. Besides having collected data through road inventories and traffic surveys, another fundamental fact must be known or approximated in order to produce a sound and efficient planning program. This other item consists of the funds which will be available. Since all highway revenues are derived from automobile taxes and Federal Aid grants, it is possible to estimate the amount of money which may be spent in a given one-, two-, five-, or ten-year program.

Funds spent in Michigan are first divided among three regions of the state. These regions were created and defined by the Horton Act, which decrees that 50% of the total funds must be spent in the Lower Peninsula south of Town Line 12, 25% in the Lower Peninsula north of Town Line 12, and the remaining 25% in the Upper Peninsula. This basic distribution must be strictly adhered to in the formulation of the planning program.

Traffic to be considered. It has been found that the improvements required to bring the state trunk line system up to a condition which would make it adequate to serve traffic which existed in 1936 would be so extensive and would require the expenditure of such large sums of money that it is impractical at the present time to plan and design an extensive program to meet estimated traffic for any length of time into the future. Consequently, the immediate planning program is designed to do the most possible with the available funds toward bringing the system up to adequacy for 1956, always of course being on the alert to accommodate increased future traffic where it can possibly be included.

Highway improvement classifications. Highway improvements are grouped into four main classes

Class I includes improvements which involve increasing the capacity of existing pavements by adding traffic lanes. This is considered theoretically to be demanded when the number of vehicles inconvenienced annually equals or exceeds 100,000. Incidentally, with an eye to future traffic and safety, the planning department does not recommend adding a single lane where increased traffic capacity is demanded on existing two-lane pavements. They feel that it is better to add two lanes paralleling the existing highway so as to produce what amounts to a four-lane divided highway. Also, they do not recommend widening existing three-lane highways to four lanes, but rather prefer adding a two-lane pavement paralleling the three-lane route, resulting in a five-lane divided highway.

Class II consists in widening existing narrow two-lane pavements. The accepted standard width for two-lane highways is 22 feet. Anything less than 20 feet wide is considered a narrow pavement and inconveniences all its users to a certain degree in that it makes necessary more careful driving and places the driver under a mental strain which he does not feel in driving on a pavement wide enough to assure him he will not be running off onto the shoulder every time he meets or passes another vehicle. Twenty-foot two-lane pavements are allowed to remain as they are regarding width, but anything under 20-foot width is brought up to the 22-foot standard if possible.

Class III covers replacing of low type bituminous surfaces and gravel or other non-stabilized surfaces with high type pavements. A low type bituminous surface is one which is approximately equivalent to the present oil aggregate surface. It is dustless and may be any of the following types: (a) surface treated gravel or macadam, (b) bituminous retread on gravel or macadam, (c) penetration macadam, or (d) oil aggregate. The high type pavements include portland cement concrete, bituminous concrete, and sheet asphalt surfaces on rigid or non-rigid bases. It is considered sound economics to place high type pavements where the average hourly traffic of the 100 highest hours exceeds 110 vehicles per hour. Cost of high type paving is justified in that it reduces cost of operation through increased gasoline mileage and decreased wear and tear on vehicles. It has been estimated that the cost of operating a vehicle on a high type pavement is about 2 cents less per mile than on a gravel surface.

Class IV of the improvement classification includes surfacing gravel and similar non-stabilized surfaces with low type bituminous mat surfaces. This type of work is done where traffic justifies some expense for improved road surface, but does not justify the expense of a high type pavement. It has been found that it is practicable to surface gravel roads with bituminous mats where the average hourly traffic for the 100 highest hours exceeds 50 vehicles per hour.

Highway improvement priorities. By drawing off the necessary tabulations from the tabulating machine and making a careful study of them it was possible to determine for each of the Horton Act regions just how many miles of pavement are inadequate to the extent of needing additional traffic lanes; how many miles of narrow two-lane pavements exist which should be widened to standard two-lane width; how many miles of highway carry sufficient traffic justify improving the surface from gravel or low type bituminous surfaces to high type pavements; and how many miles of gravel surfaced highway carry sufficient traffic to justify applying a bituminous mat surface. It is a relatively simple matter to determine what sections of highway are inadequate and in need of improvement, but the more difficult part of the problem is to rate the various projected improvements in order of their priorities.

The Michigan State Highway Department bases priorities for Class I improvements chiefly on a figure known as the number of vehicles inconvenienced annually on the section of road in question. The determination of the number of vehicles annually inconvenienced is arrived at on the basis of these factors: (a) traffic capacity of the existing highway, (b) traffic it carries expressed as the average of the 100 highest hours of the year, and (c) the traffic pattern for the given section of highway.

Thus, where existing traffic exceeds rated capacity the difference between the average hourly traffic for the 100 highest hours and the traffic capacity of the highway expressed in vehicles per hour gives the number of vehicles inconvenienced per hour. The number of vehicles inconvenienced per hour is then multiplied by a coefficient depending on the traffic pattern to give the number of vehicles inconvenienced annually.

For the other three classes of improvements, priority is based chiefly on the average hourly traffic for the 100 highest hours, those sections carrying the most traffic being given highest priority. Perhaps a better criterion for most traffic planning for improvements of these types would be the average daily traffic since these improvements benefit all vehicles using the highway instead of benefiting just those who use the highway in excess of its rated capacity. In checking priorities by using the average daily traffic the planning division of the Michigan State Highway Department found that there was little difference from the priorities as determined by using the average hourly traffic for the 100 highest hours. This might not always be the case however, and it is the opinion of the writer that the average daily traffic is the preferable basis for the determination of priorities for improvements in these classes.

The number of vehicles inconvenienced annually or the average hourly traffic for the 100 highest hours is determined for all sections in need of improvement in each of the three Horton Act regions and the priority lists made up, based chiefly on the values cited above. Other items given due consideration are the number of restricted sight distances, horizontal and vertical alinement, and the type of traffic served, whether commercial, passenger, or mixed. An item occasionally giving added priority to a given section in need of improvement is the fact that the improvement would complete or bring up to par a comparatively large section or unit of the trunkline system as a whole.

Apportioning funds by improvement classification. If the funds available were going to be sufficient to do all the work which might be needed, there would be little need of a careful planning program. It is when the available funds must be stretched and so placed as to give the motorist the greatest value for each dollar expended that the function of the highway planning program makes itself manifest.

As previously stated under the topic <u>Available funds</u> on page 10, the amount of money which will be available in any of the Horton Act regions can be quite closely approximated for any length of planning period desired. The funds are then apportioned among the four improvement classifications in the ratio of the number of miles of need for improvement of that particular class to the total number of miles of needed improvement of all four classes. This will give the percent of the total appropriation which may be spent on each class of improvement, and also determines the number of dollars to be spent in each class. The number of miles of each type which may be improved during the period planned for is then found by dividing the appropriation for each class by the respective estimated cost per mile.

<u>Selection of yearly program</u>. Knowing the number of miles of each type of improvement that may be financed in a given year, it is possible to select the roads to be improved from the priority lists. The highway planning division however does not make final selections, but selects from those sub-sections having highest priority a group comprising somewhat more than the mileage that can be improved. Final selection is made by the State Highway Commissioner who selects the sections to be actually improved, giving consideration from all standpoints including social, political, and economic factors as well as engineering considerations.

II. LONG RANGE PROGRAM

Administrative considerations. Since present funds are so limited and there is so much improvement needed in our highway system, it is necessary to prepare for future needs by making immediate plans for a remodeled financial structure to relieve the situation in the near future. There is a need for revision of tax and revenue distribution systems so that those highways which pay their own way in gasoline tax revenues get their full share of appropriations and those highways which exist as a sort of convenience for small localities and are not paying their own way should be supported from more general funds. This calls for new and improved channelization of funds among the state and local highway administrative units.

Future traffic. Although future traffic is expected to increase by 1960 to double what it was in 1936 and its accomodation will require expenditure of large amounts of money for improvements, we must remember that proper planning will see to it that these funds are spent on locations where they will earn benefits equal to or greater than their cost.

Future construction and maintenance. The Michigan State Highway Department has compiled a report entitled "A Tentative Estimate of the Cost to Maintain and Improve the State Trunk Line System for a Period Approximating 25

Years" to be used as a guide in the establishment of the new financial structure for future highway maintenance and improvement. The total cost of an estimated $ 1,046,460,000. is divided among five types of costs as listed below.

a. Reconstruction of existing roads and streets. This item includes 3,404 miles of state trunk lines which are to be reconstructed on new alinement when present pavements wear out. Estimated cost for the 25-year period is $ 205,256,000.

b. Improvement of existing roads and streets. Increased traffic is expected to demand improvement with higher type pavement or greater traffic lane capacity on 5,601 miles of state trunk lines which will necessitate the expenditure of $ 420,447,000.00.

c. Additional roads and streets. This item includes a total of 723 miles of new construction which will take the form of new routes, belt-lines for by-passing cities, and traffic relief routes in and out of the city of Detroit. Total cost is estimated at $ 74,953,000.00.

d. Limited access express ways. These are the highways which will permit the rapid flow of traffic between Detroit and the industrial centers of Michigan and the adjoining states. It is estimated that 315 miles of high speed through highways of four- and six-lane design will be needed at a total cost of $ 120,750,000.00.

e. Roadway maintenance. From a careful analysis of maintenance expenditure records it was observed that the annual maintenance cost per million vehicle miles of travel is steadily decreasing and it is estimated that it will become stabilized at approximately $ 1,035.00 per million vehicle miles in 1960. By estimating the number of vehicle miles expected each year and the corresponding annual maintenance expense per million vehicle miles, the amount required for maintenance each year was obtained and the total for the 25-year period was determined as $ 219,025,278.00.

III. ATLAS OF COUNTY MAPS

Besides providing necessary information for devising an intelligent planning program the highway survey will be used for other valuable compilations, most important of which is a series of county or base maps. A base map has been drawn up for each county of the state showing every mile of rural public road, every farmhouse or residence, every church, school, store, mill, and mine which might be an origin or destination of traffic. They also show all railroads, navigable streams, airports, railroad stations, public wharves, and every city, village, and town no matter how small. These base maps will be kept completely up to date recording all changes in location and new construction, as well as recording all changes in other information depicted such as growth of residential districts, new airports, and new industrial and economic production facilities. Thus will be provided a road atlas of county maps more complete and accurate than has heretofore been available.

On these base maps all roads are shown as open bands, and from the county base maps several special series will be drawn by overlaying and drawing off specialized information.

Highway and transport series. The chief function of the Highway and Transport series will be to show existing surface conditions on all highways. This will be done by filling the open highway bands with standard conventions to show the type of surface and its condition.

Postal series. This series will indicate condition and state of improvement of rural highways used as rural free delivery routes and star mail routes.

School bus series. This series will be devoted to showing exactly what highways are being used in transporting school children between their homes and schools.

Future series. Two other series are being contemplated: one to show by conventional symbols in the open highway bands the density of the traffic carried by each highway; and another which will show all items pertaining to development of recreational areas in each of the counties of the state.

It is obvious that a series of maps presenting such a widespread range of complete information will render valuable service to all sorts of economic, industrial, and social planning agencies. For example, power companies can use them for estimates of potential demand, industrial concerns will use them for plotting sales and production territories, and they will provide agricultural specialists with information vital to defining areas of relative soil productivity leading to optimum utilization of all agricultural lands. Also they will be of inestimable aid as guides for enumerators working on the Decennial Federal Censuses.

CHAPTER IV

CONCLUSIONS

The methods of highway planning in use by the Michigan State Highway Department are as sound in principle and application as can be expected under present conditions; however, there are a few items involved in the procedure which discredit its acceptance as an exact science. These shortcomings are not the fault of the methods, but rather a result of the peculiar nature of the highway planning problem itself. It is difficult indeed to predict what the requirements of our highways will be 25 years from now, when the whole field of highway engineering is scarcely 25 years old itself.

Since in building any highway the object is to make it adequate to carry the traffic which will be passing over it near the end of its economic life, two doubtful quantities are involved in the problem; namely: how many years of service life may be expected of the highway, and what will be the traffic on the highway at the end of that time. Under present conditions these quantities are merely good approximations at best. There is a need for further intensive research on these two items, and due to their inherent characteristics it will be a considerable number of years before their doubtful nature can be eliminated or reduced to a minimum. Traffic studies must be carried on continuously if at any time we hope to be able to accurately predict future volumes and characteristics. Obviously time itself is the chief obstacle to accurate determination of highway service life.

Much has been done since the automobile first made its appearance, but even more remains to be done. Highway design, as regards efficiency, economy, and safety, is a long way from perfection. The next few years will see improvements in design as well as in construction and maintenance methods.

Nevertheless, we must not let our judgements of present methods be too much colored by our vision of things to come any more than we should be tempted to call our system good enough as is just because it is a decided improvement over what it used to be. In the opinion of the writer of this paper, the Michigan State Highway Department is doing a good job of following the old army axiom of "doing the best you can with what you have", as well as going a little further by looking ahead to be better prepared for what the future will bring.

The present system of handling immediate planning programs is all and more than can be expected in view of limited funds and relatively limited records and data to work from.

The long range planning program is a step toward eliminating problems on the present financial structure in that its goal is the establishment of the new financial structure which is so obviously required to meet highway planning problems of the future.

It is natural to assume that changes and improvements will be made with each passing year as highway design improves and traffic tendencies and needs become more definitely predictable.

This paper has endeavored to show that the Michigan State Highway Department is facing the cross-roads of highway planning and administration with a keen understanding of the course it must follow if highway transportation is to reach its ultimate in service to the general public. A broad future lies ahead and it must be met with vision, foresight, and imagination. There is no such thing as standing still or maintaining the <u>status quo</u>. If we do not go forward, we will surely go backward. Tennyson struck the right note when he said in his <u>Morte D'Arthur</u>, "The old order changeth, yielding place to new". The Michigan State Highway Department is doing its best to assure the new order's being a true order in the highest sense of the word.

LITERATURE CITED

Papers presented at the 24th Annual Michigan Highway Conference, Ann Arbor, Michigan, February 15-17, 1938

Burdick, Chester C., _Getting the Facts_

Van Wagoner, Murray D., _The Cross Roads of Highway Administration_

Kennedy, C. Donald, _The Motorist's Stake in the Highways_

Coons, Harry C., _Mapping Michigan Roads_

Fairbank, H. S., _The Utilization of the Traffic Survey_

Paper presented at Annual Meeting of Greater New York Safety Council, New York City, April 14, 1937

Sheets, Frank T., _The Highway of Tomorrow_

Reports

Michigan State Highway Department, _A Tentative Estimate of the Cost to Maintain and Improve the State Trunk Line System for a Period Approximating 20 Years_

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