STATE HIGHWAY DEPARTMENTS

ADMINISTRATION and DUTIES

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Rhode Island

South Dakota

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A General outline of State Highway Control through its Administration and Construction and Maintenance

A State Highway may be taken to mean any highway in a state, this may be used more specifically to designate the highways bearing the interstate highways signs outside of roads and streets of towns and cities. The term State Highway Department as I shall use it throughout this thesis shall be understood to mean any body or group of bodies directly responsible for upkeep, maintenance, and construction of State highways and also may refer to any body or group of bodies directly or indirectly connected with the former.

The Term upkeep and Maintenance will in general be used synonimously to refer to the repairing of pavements, blacktop, and brick; the grading of gravel roads; dirt fill, banks, and drainage; and the general policing of highways.

The term auditing shall, as I use it, refer to the general keeping of books; the collection of taxes, fees, and fines; and the distribution of costs, including wages, salaries, materials and equipment.

FUNCTIONS

Each state has its own system of highway organization. The system may vary in method of appointment of officers.

In many cases the governor of the state appoints the highway commission consisting of one man or two men holding equal rank or several men. In some cases he appoints one man from each district into which the state is divided.

In other cases the hig way commission is elected by majority vote of the people. This is often the case when only one or two men are to be the commissioners.

Although I have not run across any such case in state highway organizations, I have found cases in county organizations where the men who become commissioners are men who advanced from wage earners of the county payroll , right on up the line, either through a remarkable ability, much drag or support, or the elapse of time leaving higher offices vacant.

Sometimes the commission consists of district commissioners who get together for conferences.

Usually when more than two men get together to make up the commission they appoint one of their number to become head commissioner or board supervisor.

The duty of the State Highway Commission varies with the various states but mainly they consist of the same essential things. They adjust the various groups

over which they preside, so that maximum efficiency and perfect coordination of departments exists. The commission does which roads and bridges in the state need to be built or repaired. This body then proceeds to authorize the building of the proposed addition or, in case where the project is large, turns the proposed idea, along with necessary material and data, over to the state legislative body who either pass on the project or turn it to the people for vote.

The Auditing Department of the State Highway Department

The Audit Section is the Highway Commissioner's means of assuring himself that every expenditure of his department has been legally authorized. Also that it complies with the regulations of the fiscal agencies of the state government. This section also assures him that each expenditure is financed by using funds, from that item of the department's budget which he planned to use for financing this particular expenditure. This assures him that the conclusions which he periodically draws by comparing actual expenditures with planned expenditures are reliable.

The Audit Section reports directly to the Highway Commissioner to eliminate the possibility of its activities being influenced by supervision having less scope and responsibility than the Highway Commissioner's

The Highway Department's Audit Section constitutes its official cooperative connection with the auditors of State Accounts.

The records and procedures with which the Audit section is concerned are numerous and diverse. They comprise the activities listed below.

(I) Authorization of payments to contractors for highway construction work.

The authority of the parties who approve vouchers for payment to contractors is verified, unit prices compared with contract agreements, the mathematical accuracy of computations is checked, and the charging of the expenditures to its authorized means of financing is checked.

(2) Requisitions and vouchers for supplies and materials.

Requisitions are checked to determine whether adequate funds have been made available to finance the purchase and whether part or all of the commodities requisitioned are already available for deliveries from stock on hand. Vouchers are checked against receiving records; prices and discount terms are checked with purchase orders; recording of vouchers is verified to insure that expenditures are financed from the proper accounts, and thereby carry out the intent of financial plans.

(3) Payrolls.

The Audit Section checks payrolls as to mathematical accuracy; as to rates of pay; as to conformity to the regulations of the State Personnel Director; and as to the propriety of sick leave and vacations. In this process the Audit Section must take account of all changes in status of employees which have become effective during the period since the last payroll.

The Audit Section also checks the distribution to control accounts of the amounts paid for Personal Services to insure that they are financed in conformity with the departments financial plans.

(4) Traveling Expenses, and Subsistence.

The Audit Section verifies the authorization of all claims for traveling expenses and subsistence, and see that these items are charged to the planned means of financing. Its responsibility also includes determining that adequate funds are available to finance such expenditures.

(5) Inter-Department Charges

In order to purchase to advantage, the highway department has on hand at all times large quantities of stored materials. These materials frequently total values of several hundred thousand dollars. They are retailed to the various uses of the department, such as maintenance, roadside development, town aid activities, and other more detailed operating activities. These retail transactions run into a great volume of transactions daily. The Audit Section checks the authorization, the distribution of charges to planned means of financing, and the mathematical accuracy of all records concerned with these transactions. Department-owned equipment runs into several hundred items, and is valued at more than a million dollars. Some of this

equipment is charged onan rental basis to the object of expenditure upon which it is used; other items are of such a nature that they are not charged on a rental basis. These charges must be verified as to the correctness of the rates at which they are charged, mathematical accuracy of all transactions, and distributions of charges to the proper account. The department owns a substantial number of buildings and plots of land. The operations of the Property Control Division concerned with depreciation, insurance, and appropriate rental charges must be verified by the Audit Section. Other sections of the department conduct a large retail business in blue-printing, photostating, mimeographing, and similar services, not only for the highway departments use, but for a considerable number of other state agencies. The Audit Section must check the propriety of the accounting for all these detail activities.

The Auditors of State Accounts maintain a resident staff in the highway department. Cooperation between this staff and the highway departments Audit Section is continuous. This method of operating has proven to be highly satisfactory through a period of many years.

The Audit Section, through their contact with the operating organizations of the highway department, and through their close relations the Auditors of Public Accounts, are frequently in a position where they are of substantial service to the other units of the organization through calling timely attention to possible sources of delay or conflict in procedures. These services help to keep moving smoothly the heavy volume of routine work involved in accounting for, and paying for, the highway department's large and diversified program.

Patroling of State Highways

Law is indispensible to civilisation. Civilisation must be protected against those who have no respect for law. Crime and criminals are well organized-forming even business enterprises. Since crime is so well organized, those forces which are to combat law breakers, the police forces, must be just as well, or better, organized than the criminals. Political subdivision lines are disappearing and strides toward more efficiency are being made constantly in law enforcement. Since highways are the arteries of transportation, they must be well policied, and the utmost efficiency in this task will be obtained when each and every law enforcement agency co-operates, and when the petty jealousies existing between various agencies is eliminated.

In many states the job of policing the state highways is done by a seperate organisation, the State Police, but in some states, Ohio, Minnesota, South Carolina, and others, a division of the Highway Department of the state patrols the highways. In most states the State Highway Patrols are a rather recent development (Ohio 1933) but their need became evident with the great increase in traffic, and their accomplishments have more than justified their existence.

Nearly all of the states have training schools which the prospective partolman must attend and pass in order to qualify for a job on the highway patrol. These schools have age and physical requirments which must be met before the applicant may attend school. Mental tests must also be passed before entrance into the school can be effected. Approximately fifty to sixty percent of the students entering these training schools are finally graduated. As would be imagined, the purpose of these schools is to teach the students how to best discharge the responsibilities of the State Highway patrol. Courses are conducted in highway traffic laws; motor vehicle registration laws; regulatort laws; driver's license laws; the law of arrest; rules of evidence; preservation and presentation of evidence; first aid; geography of the state; motorcycle riding; use of firearms; jiu jitsu and self-defense; observation and many other practical courses which would be of value to the patrolman. Instructors for the schools are carefully chosen for their knowledge of highway patrolling and their ability to teach. These training school are conducted on a semi-military basis and are subject to training school rules and regulations. The training period is usually from ten to twelve weeks duration. Except for Saturday evenings and Sundays the students are engaged in class room

work, field work , lectures, recreation, or study. For infractions of rules, penalties are meted out, and if the violation is serious the student may be dismissed from the school. All equipment, such as law books, first aid supplies, pencils, maps, etc., as well as meals and lodging are furnished by the state. A small salary is usually paid the students while in school, a typical day of a school might be:

6:00 A.M. ——————————————— Reveille
6:30 " ——————————————— Calisthenics
7:00 " ——————————————— Breakfast
8:15 " ——————————————— Inspection
8:30 " ——————————————— Class
9:30 " ——————————————— Class
10:30 " ——————————————— Class
11:30 " ——————————————— Lunch
12:30 P.M. ——————————————— Class
1:30 " ——————————————— Class
2:30 " ——————————————— Recreation
3:00 " ——————————————— Class
4:00 " ——————————————— Class
5:30 " ——————————————— Dinner
7:00 " ——————————————— Lecture or Study
10:00 " ——————————————— Taps

Saturdays are devoted usually to weekly tests and inspections. On Sundays, when the student is not on leave, he may receive guests.

The curriculum of most police training schools would probable be about like this:

Military Drill ——————50 Hrs.

Motorcycle instruction ——————100 Hrs.

Motor Vehicle laws ——————72 Hrs.

Criminal procedure ——————24 Hrs.

Geography (state) ——————12 Hrs.

First Aid ——————15 Hrs.

Reports and forms ——————4 Hrs.

Accident investigation ——————6 Hrs.

Self-defense ——————24 Hrs.

Fire arms ——————48 Hrs.

Public utilities, rules, laws, regulations — 5 Hrs.

Government ——————6 Hrs.

Communication ——————6 Hrs.

Finger printing ——————6 Hrs.

Policies and procedures ——————12 Hrs.

Calisthenics ——————30 mins. per day

Besides these training schools many states hold refresher or review schools for the officers. These schools, as their titles indicate are for the purpose of reviewing subjects related to highway patrolling and include usually a study of laws enacted during the interverwing period since the last refresher school. These refresher and training schools have done much to increase the efficiency of the police forces, and thus help to cut down crime and accidents.

The duties of the highway patrols are many and varied. The fact is, the duties of the police are too great for them to handle. The number of police are overworked and as a result the efficiency of the patrol suffers. One of the main duties of the partols is to see that highway laws are enforced. This in itself is a tremendous task considering the number of vehicles on the roads, and the amount of highways to be patroled. The use of radio cars has greatly increased the efficiency of the police, but if the highways are to be properly patroled many more patrolmen must be available. Many people think of patrolman merely as men in blue uniforms who will give you a ticket if they catch you doing something illegal. But they do much more than that. For example, in Ohio during the floods of 1936 and 1937 the highway patrolmen did heroic work in rescuing stranded persons, and saved many lives by keeping in communcation thru the police radio, with small towns when other communication was cut off. In times of disaster the police are always ready and prepared to help alleviate the sufferings of others, oftentimes at the risk of their own lives.

When ever large numbers of people gather for a football game, a state fair, or a convention or something siiilar, a traffic problem is created. Accidents must be prevented, traffic must be kept from getting

tangled up, and the automobiles must be parked. It is the job of the state police to see that these things are accomplished quickly and efficiently.

In times of labor disputes, and strikes, and mass meetings where violence seems likely to occur, the police are protected and order maintained. Oftentimes, in the line of such duty, patrolmen are killed or injured. Another important work of the highway patrols is the apprehending of criminals. In this dangerous work the police are aided immeasurably by the use of radio cars. When a report is received that a bank has been held up, or a murder committed, the alarm is immediately broadcast to all police cars and the roads are blocked off according to a very carefully work out plan. Each car that passes is examined, and if the criminal is traveling on a highway after the crime the chances are very good that he will be caught. This blockade system has proved very effective, and is in use in a majority of the states.

In many states the highway patrolmen conduct examinations for drivers licenses, and hold safety clinics for the education of drivers. Patrolmen are trained in accident investigation to determine violation and persons causing the accident. In Minnesota, since officers have been trained in accident inves-

tigation technique, drivers have been convicted for accident-causing violations in approximately 45% of the accidents which officers have attended. In some states warning tickets are issued to drivers violating the law in a case which, if the first offense, would not be considered sufficient to justify arrest. A driver's record is made from these warning tickets and if a second ticket is issued for the same violation, the driver is usually brought to court charged with the violation. The following table will indicate the diversity of types of arrest made by highway patrolmen. This table, from Ohio, covers a three year period, 1935 thru 1937 and is generally typical of the majority of states.

Classification of violations	Number of violations
Motor Vehicle registration	4,768
Reckless Driving	5,610
Failure to stop at Main thoroughfare	1,585
Lights	2,537
Size and weight	2,199
Motor theft	334
Manslaughter	49
Driver's license	605
Driving while intoxicated	3,125
Failure to stop after accident	328
Failure to stop for school bus	271
Brakes and signal device	778
Stealing or destroying highway property	111
Other	426

Total 22,816

Other duties of the highway patrols include first aid administration, checking truck weights in order to protect the roads, inspecting cars, trucks and school busses, issuing safety warnings, apprehending hit and run drivers, and various other activities. Minnesota's police have adopted a program of pedestrian control and education. Many states have accident bureaus whose job it is to cut down the accident rate. In most states these bureaus have been successful and accidents have been reduced as much as 50 to 75 %, despite increased travel on the highways.

The Highway patrols then, are extremely necessary and vital to any highway system. Because of the great increase in travel over highways, and because of the equally large increase in the number of miles of highway to be patrolled, the state police forces have been enlarged, but they require still more enlargement if the job is to be done effeciently. The quality of most state highway patrols is very fine, but usually they are lacking in quantity.

The Roading Maintenance Department of the State Highway Department.

The Maintenance Departments Functions and its Organization as associated with the Maintenance Policies.

In general the functions of this department consists of essentially the same things in all states. They maintain the travel way and shoulders of state highways to keep them in a good and safe condition for travel, they must clean and repair drainage systems of state highways, including ditches, gutters, pipe culverts, sewers, drains and appurtenances; also to add to such drainage facilities as may be required. In order to eliminate dangerous accidents.

Ordinary highway maintenance is the most important of the junctions of the highway maintenance division, costing more, in general, than all of its other activities combined. Many different ideas and schemes are being made annually to reduce the costs.

The past few years have seen large increases in the mileage of the state highway systems. Some state have shown larger increases than others, either due to lack of roads previously or due to the forsight of the various highway departments. There have been still larger increases in the square yardage of roads maintained, owing to steadily increasing widths of travel way, as

as highway standards are improved, and to the large mile age of multiple lane highways now being built effecting this work and prepare specifications for work to be done within the highway right of way. Although in some states special organizations are set up for the erection and maintenance of highway directional and warning signs and traffic control devices, and the painting of lines and warning signs on pavements, other state have this full u day highway maintenance. The maintenance department coo- perated to the fullest extent with the construction and engineering department in bettering highways so far as the needs of traffic are concerned. They do this by keep- ing a record of accidents on the state highways and prep- are special reports on any particular piece of road which is under consideration for improvement. Many surveys are made by this department so that they may prepare designs, plans, specifications and estimates for all highway im- provements made by maintenance forces; they also control and supervise work done in accordance with these plans and specifications. Although most of the experimental work on material is done in the engineering laboratory, some of the experiments are conducted by the maintenance depart- ment in cooperation with the engineering department.

As seems logical after studying the highway main- tenance functions we general ly can divide the main-

tenance staff into three distinct division as follows:

1. The division in charge of all work in maintaining and improving the surface and shoulders of all roads, and guide railings; also snow and ice work.

2. The division in charge of all work in maintaining and improving drainage structures.

3. The division in charge of highway control.

Also we generally find a man who helps design roads from a viewpoint of maintenance and a man who helps in the head office in order to bring the field together with the office.

The work performed by the State Highways maintenance crews is classified as follows:

(1) Ordinary highway maintenance. Maintenance of travel way and shoulders to keep them in a good and safe condition for travel; cleaning and repair of drainage systems including ditches, gutters, pipe culverts, sewers, drains and appurtenances; repair and painting of guide railings; in short, all the work of the bureau, except as specifically noted below.

(2) Special maintenance. Repairs to pavement, road bed, drainage structures and guide railings that result from extraordinary storm damage; replacement of defective drainage structures, replacement of defective guide railings; "mud-jacking" of concrete pavement slabs to restore them to proper position, and patching of bituminous concrete pavements (i.e. sheet asphalt, etc.)

(3) Capital outlay. Stone surfacing of macadam and gravel roads; construction of additional surface and surface and subsurface drainage structures that were omitted in original construction of our older roads; modernizing the cross section of high crowned roads; construction of additional guide railings found necessary to eliminate hazards; widening of road bed on narrow highways to give a greater width of travel-path.

(4) Removal of snow and sanding of ice, referred to as winter maintenance.

(5) Highway control in issuance of permits, and in highway markings and traffic control.

All of the above types of work are done with state highway forces. In addition, work included under the Heading "Special maintenance" and "Capital outlay" is done by the Construction Bureau under contract, at the request of the Maintenance Bureau, who the job is of sufficient size to permit the contract procedure to be economical.

The fraction of the highway dollar going into ordinary highway maintenance, special maintenance and winter maintenance in three recent years is 10.89%

The condition this department repairs and paints is. Guide railings of all kinds along the state highways, and make extensions of guide railings as are warranted. They also remove snow and ice from the travelled portions of highways, sand icy surfaces on hills and curves, at main inter-

sections, straight-aways at the foot of hills, and erect snow fences along state highways to prevent, as far as possible, excessive drifting of snow on the traveled portion of the highways. The maintenance department must maintain adequate repair shops for repairing and overhauling all state highway department equipement. In order to meet changing conditions of travel the maintenance department makes minor improvements to the traveled way and shoulders of state highways, these improvements modernize the highways. Many times special conditions such as severe storms or floods cause washouts which must either be repaired or prevented by some special means. Other special things might happen to highways and must be prevented or repaired. The maintenance department must control the highway to prevent public utility companies, municipalities, and private persons from taking over highways and must,,in some states, control the transportation of excess loads on state highways. This department undertakes to control tree and shrub permits increase in yardage is the fact that newer types of construction require less costly maintenance per square yard; but offsetting this are the facts that newly-built roads comprise a relatively small portion of our highway mileage and that the old roads are consequently becoming more costly to maintain as they approach a con-

dition in which they are so completely worn out that they can no longer be maintained at all, but must be rebuilt. To keep the cost of ordinary highway maintenance from rising requires intensive thought and strenuous efforts. Nevertheless the cost has been kept from rising and indeed, has been substantially reduced.

The reduction in maintenance costs which have been accomplished through the discovery and adoption of various improved methods of carrying on this work. The improvements from which we have benefited, and on which we rely for a future reduction in costs, include the following:

1/ Extension of the policy of changing maintenance of macadam and gravel roads from annual treatment with light bitumen and sand cover, to infrequent treatment with heavy bitumen and stone surfacing.

2/ Extension of correction of drainage conditions where waterbound macadam and gravel roads now break up each winter and spring, and where seepage of water requires costly removal of ice each winter.

3/ Limitation of bituminous shoulder maintenance to a definite and economical width.

4/ More general asphaltic treatment of shoulders with coarse aggregate, to increase the time interval between applications.

5/ Change of shoulder construction to a more permanent type, as rapidly as feasible.

6/ More economical methods of mixing patching material.

7/ More economical methods of screening sand for maintenance operations.

8/ More extensive use of modern equipment.

9/ Interchange of equipment between bureaus to the fullest extent.

10/ More adequate cost control system; stimulation of rivalry between districts, and reduction in number of districts to reduce overhead.

Since a good many states have drainage systems which date back to early times, we find that the systems which were adequate then are very inadequate in the present day. Much of this mileage was built with very inadequate provisions for sub surface drainage.

Extension of Correction of Poor drainage conditions:

A great many miles of the Connecticut highway system were built years ago when the art of road building was much less advanced than it now is. Much of this mileage was built with very inadequate provision for sub surface drainage.

This has had two very unsatisfactory results: water seeping under the road surface alternately freezes and thaws during the winter, and in so doing breaks up the road surface, requiring it to be reshaped during each spring season. This means expensive maintenance; it entirely precludes the maintenance under stone surface referred to in the Extension of Stone Surfacing. Obviously a stone surface cannot be satisfactorily applied to an unstable road base. Second, lack of drainage facilities often results in a con-

tinous seepage of water during wet periods onto the travel way. During winter weather, this seepage water freezes on the road surface, causing a hazardous condition that can be eliminated only through expensive sanding and ice removal operations. Where drainage facilities are inadequate, either or both of the foregoing condition may result. During the past few years it has been found and recorded in most states the number of miles of highway which must have an increase in repaired drainage in order to keep a stone surface on the highways. Stabilization is an important part of state highway maintenance divisions work. A part of this work is done by the maintenance crews and a part by contract to construction crews. Costs of these types of doing the work is being carefully studied in order to determine the conditions under which either one of the two methods is preferable. Their is probably no work that the highway department has done which gives a greater return than this correction of bad drainage conditions. This drainage correction pay for itself in a y/ period of from five to six years through its decreasing the cost of snow and ice removal.

In most states it has been found that the oiling of roads has been an expensive procedure. This expense can be cut down by limiting the amount of shoulder oiling to an effective width. Then by grading farther and by adding topsoil to outer edge, grass can be grown which tends to beautify highway and is cheaper to maintain. This general practice thusly straightens the travel way and lends a smooth beauty to the road which had not been beautiful before.

Another costly item is the material and labor necessary in patching roads. The material used is generally a light viscosity bit men mixed with gravel. The general cost of mixing is high due to the fact that no general method of mixing is used. Some of the methods used are:

(1) Hand labor

(2) Use of snow plows

(3) Concrete mixers. None of these are satisfactory because in the case of hand labor the labor cost is to high, in the case of snow plows the mixing is not even, and in the case of concrete mixers the gravel must be mixed too long or else it must be mixed with a li ht bit men. One method to obtain fair results is to

(1) Grade the gravel

(2) Use a heavy viscosity bitumen

(3) Fix the material at the pit

(4) Mix and measure by means of a power shovel

(5) Spread bitumen on gravel, with a spray pipe

(6) Mix long enough to obtain an even mix. Any material to be used should be studied thoroughly in the highway laboratory. As a great deal of this material is in use all of the time, a continuous study would be worth the while of the department. As roads are stabilized by sub-surface drainage the cost of repairing will be cut down. A valuable use for the patching material is along shoulders where oiling

is necessary. This cuts down oiling cost tremendously and starts a savings.

A high cost to state highway maintenance departments is the buying, holding and distribution of sand. This sand is sometimes used in oiling and in many states is used to decrease the accident hasard of slippery, icy pavements.

Many unpredicted repairs must be taken in account when the figuring for future highway costs. Hurricanes and floods reduce the life of pavement and roads tremendously. No person can forsee the exact amount of money necessary to repair this damage. Sometimes mud jacks are used to take dips out of pavements due to washing and settling.

Guide fence posts are found to have a longer life if they are pressure creosoted, although the cost is high the life of the post is almost doubled. Certain states have tried to paint their posts white and although this is very satisfactofy in its appearance, painting can be used on only non creosoted posts due to the constant so called "bleeding" of the creosote. Black posts lend a quiet beauty to the traveled road and are certainly satisfactory for day driving but they are very hard to see at night. For this reason many states have adopted the plan of placing reflectors on the guide rail posts. Concrete posts are sometimes used but are found to be impractical in most cases. Some times posts have been creosoted to a point a few inches above the ground but this has not proven very satisfactory.

Maintenance of worn bitum nous concrete pavements is a.c mplished by removing the section in need of repair and replacing this section with a similar m terial. The cost of re airing roads in some states is taken down by the adondonment of operation by utility companies of trolley track areas and the replacement with new material . Cracks in pave- ments are filled with hot liquid asphalt. Patching maintenanc e of bitominous concrete can be cut down by sto e sur acing. This type of surface is also less susceptible to skiding than other types of highway. It is believed and it is ace- omplished in some states that patching can be practically eliminated .

It has been found that a better maintenance can be had by dividing the state into smaller sections for a more thorough handling of repairs.

HIGHWAY PLANNING SURVEYS

Since the turn of the century and the rapid development of the automobile an added burden has been placed on all public corporations, the county, city, state & the country, that of providing ample safe, and economically sound system of highways. Previous to this time, the construction and maintenance of roads was more or less a local concern. A farmer wishing to go to some community would hitch his horse to his buggy and drive to the nearest already established road which led to his destination. In the course of reaching this common road he would have in mind the principle that a st. line is the shortest distance between two points, but as a rule he would keep his buggy on high solid ground and would circle all obsticles. The resulting road, serving its purpose satisfactorily, had no initial cost, required little upkeep and was of concern only to a few people. Where a number of people made use of the same road, often times cooperative effort was made to improve the roads but the type of vehicles used and the extent of travel were of such a nature that the highway situation was comparatively simple.

Then came the automobile; highway traffic increased a thousand fold, roads were traveled as much higher speeds, were subjected to heavier loads, and soon became of great commercial importance. To meet the ever arising problems seemed to fall to the duty of the state. The state was of optimum size to tackle

highway problems. Financial aid was available from the Federal government and local communities took care of their own personal problems best the states were and are concerned with the intraslate commercial highways and in most cases also those highway which are essential to tourist travel.

To aid in the planning and construction of new highways many states have conducted surveys to determine as nearly as possible what traffic conditions they would need to plan for. Their main objective being to furnish safe, adequate and attractive roads for the use of the traveling public. Safety and convenience in the movement of traffic, control the necessity for expenditures on road improvements, for these reasons, individual projects are generally thoroughly analyzed to the existing and future anticipated traffic before locations are made and plans prepared. Cost of construction, right-of-way and scenic attraction are other factors effecting the locations of road improvements.

The decision as to the type of highways to be constructed is made on the basis of the volume and nature of the traffic that will be served. The number of vehicle that use a route each day and the percentage that are heavy and slow moving determine to a large extent the width, type and strength of wood surfaces and structions.

The average rate of speed of the traffic on a road determines the degree of covature and rate of superelections used in the design of the pavements.

When the location of a proposed road is once determined, it then becomes the duty of the locating engineer to gather and record information. This information is needed by the designer and consists of notes and sketches, showing the proposed road alingment, and the terraine and topography of the adjacent territory, right of way, drainage conditions and types of soil encountured.

State departments whose main functions is the maintaining of a continuous survey of existing highway conditions preform duties similiar to the below mentioned.

1. Make special studies of specific highway problems
2. Carry on st to wide traffic surveys and develop traffic flow, maps showing annual average 24-hour traffic volumes.
3. Continue the scale survey and analyze the data to determine types and sizes of vehicles and loading fractures.
4. Complete the financial survey to bring local road finance data up to date.
5. Complete field work and bring up to date country highway and transportation maps.
6. Make city grade crossing surveys for the purpose of establishing priority of improvements.
7. Complete state highway system strip maps of each route showing mileage, width of surface, grade and right of way location of all bridges and culverts and date of its construction.
8. Make city connecting link surveys and keep up to date

connect up link information on the state highway systems.

9. Study of the establishment of secondary roads. By taking a specific example of a Highway Planning survey in operation it can be shown how involved and comperhensive these surveys are. In 1935, when the State-wide Highway Planning surveys were instated, Ohio started an intensive study of all country roads, township roads, city streets, the vehicles and the drivers, as well as the state highways for it was realized that all of these are a part of an intergrated transportation systems. This is a scientific age and so a scientific study and analysis of the following native was made.

A road inventory having for its purpose the logging of every mile of road outside of municipatities, noting the physical characteristics and the location of all establishments which effect the flow of traffic was made.

Road data taken was of this nature.

Graded width

Pavement width

Pavement type

Surface conditions

Riding qualities

Grade of 7% and over

Data for bridges and culverts

Location and name of stream

Kind

Materials

Length over all and span length

Width between curb or railings

Maximum distance roadway to flow line

Type of draw spans

Type of protection for draw spans

Schedule of toll rate, if any

Posted load limits, construction dates, etc.

Location, size & kind of large pipe culverts

Railroad Crossings

Road gradient to and from

Angle of crossing

View of approaching trains

Type of protection

Daily train improvements

Time crossing is blocked by switching trains

Also minute information was recorded concerning off-the road structures and establishments which would influence in any manner the type and volume of traffic existing in their vicinity.

On the State Highway System all curves of five degrees and over were located and measured. All State Highways were logged through municipalities and county and township roads were logged in municipalres to their intersection with the state highways.

Studies by the U.S. Bureau of Public Roads show that for driver of a car moving at sixty miles an hour on a two or three lane pavement safely to pass a car moving the same direction

at forty miles an hour he must be able to see ahead 1000 feet. In order to locate and measure those places on the state system where this condition does not prevail, the Ohio Survey developed a sight distance apparatus which proved so successful that it was adopted by nearly all the states makeing these surbeys.

The check of vehicular traffic on the roads was studied at a large number of various types of stations located at stategic points on the road nets. On the state highway system this types of stations consisted of; Keyweight stations, portable scale weight stations, 8-count primary stations, 2-count primary stations and 1-count primary stations. The data gathered at these stations can be combined to include. State of registration, type, make and year model, number of trailers, type of body, capacity, commodity carried, loaded and empty weight, origin and distination, wheel load of the behicles. Traffic volume was also measured at the minimum, maximum and average times of the year by electric counters which operated continuously and manually for period varying for existing conditions.

The primary purpose of these phases of the survey is to assist in solving the problem of equitable imposition and distribution of motor vehicle and other revenues used on highways, roads and streets. In addition, they indivate the probable future financial resources available for the whole highway program in view of the fact that the size of the highway system should be based, not upon the ability to pay

the first cost of construction, but upon the willingness to pay indefinitely to keep up what ever is built.

This required a detailed examination of the records of the state and all its 4,500 tax collecting and tax spending sub-divisions. It also entailed sending questionaires to one half of the passenger car owners and all of the commercial vehicle owners asking for the license description of the vehicle, fee, mile driven within and without the state, and the miles per gallon of gas line.

One of the interesting results of these studies was to show how the drivers, grouped according to residence, used the state highways, the county roads, the township roads, the city streets, and how much cost group contributed toward the cost of those classes of roads and streets.

The road costs are being determined from the records of the State Highway Department embodying statistical studies of the costof construction, maintenance costs, salvage value, and surface life for the various types of surfaces. These are their correlated with figures on traffic.

These studies have two primary objectives. (1) The determination of the probable average surface life and rate of retirement for each type of surface in order that the future necessary reconstruction can be forecast. (2) The determination of the annual roadway costs for the several types of surfaces.

Construction of Highways and Bridges

A decade or so ago it was frequently predicted that a few more years would see the state highway system built to completions and that from then on the principal duties of the state highway departments would be to physical plant. It is now evident, however, that we are actually in the midst of a development of motor vehicle transportation which makes new and heavier demands or highway administrations engineering and financial resources. Design and constructions of facilities still hold first place among the functions of the department.

The ideal method of meeting these responsibilities is through long-range construction programs based on an accurate long-range view of the requirements of traffic, the conditions of the existing plant, and the financial income which will be avilable annually. Even if income is somewhat difficult, such information permits the administrator to direct expenditures according to the priorities of need.

The main trouble in the highway departments is the influence of politics. In the change of administration we find that any long-range construction program was practically impossible due to the need of the persons holding office of making a showing for re-election they then are trying with the best of their ability to build up a far reaching program.

Four principle fields are believed to be in need of attention. These are the trunkline streets and highways

in and immediately around the larger municipalities, the most heavilt traveled pri art trunklines, the highways serving the resort areas, and the so-called farm to market road.

During the past few years a great deal of money has been encumbered by construction contracts or expended through the Works Progress Administration in trying to help the individual states carry out building programs. Many projects were involved such as highways, highway bridges, grade separation, dock improvements for ferries, and other auxiliary construction.

Much of the construction of roads takes place in t e various cities of a state. This work is done due to the inability of the cities to take care of this construction themselves. In some of the larger cities the cost of widening streets is very large due o to the necessity of clearing and construction along the street. Property in these larger municipalities have their values based upon foot frontage and the owners are reluctant to sell t e the city or state. It also falls within the duty of a state highway department to build by-passes and belt lines in areas adjacent to out-state cities. The state highway department must also take upon itself the maintenance and construction of United States highways. When the whole surface of any road need repairing, it usually is taken care of by the construction department because this department has the equipment necessary for such mass operation. Those grade separations and bridges found necessary for safety require a large part of the time of the construction department. In some states we find that the amount of unpaved state h

highway is decreasing at a rapid rate, while in other states the number of paved roads can be counted on the fingers of one hands.

Another of the duties of the construction departments is the improvements of primary roads due to inadequate present conditions. Among the things falling under improvements are widening of main lines, banking of sharp curves or elimeninations or protection of grade crossings, and the relocation or building of new sections. A new type of construction is taking place in some states. Looking into the future they find that it is best to build a two lane highway to one side of the center of the right of way to make possible the eventual development into a divided roadway.

The necessity of an attractive road has been pointed out in many instances. We find that not only do we increase the number of tourists but the increase makes it easier to drive and brings out the local residents who otherwise would hardly ever vacate the old homestead except for necessity.

"Farm-to-market roads" is the name ordinarily given to secondary highways in argricultural sections which lead to county seats and other local marketing centers. Because the farming regions and recreational areas are somewhat interspersed, these roads are frequently of equal value to farmers and tourists.

Although improvement of this type of roads is a major issue with with the state highway departments, at first practically all of a construction allotment of funds was required to match Federal Aid allotments which could only be expended on designated primary

routes. Nevertheless, a considerable and increasing milea e was improved each year, mostly with the newly develo ed oil a g- regate surface. Finally, however, the Federal guvernment started helping on secondary roads with the initiation of the Federal Aid Secondary program and since that time their has been a mark- ed increase in farming rte market road improvement. Many roads are being and have been selected from the state and co nty sys- tems of the various states. These roads have necessarily been selected very carefully in order to be eligible to par icipate on a matched fund basis in Federal allocations for their im- provements.

A system or program is found very necessary to successfully extend and improve any states secondary roads and the bridges on these roads, while in agricultural or farming areas an oil agg- regate was found to be sufficient to successfully hold down the dust. The reason in this case was the ability of such an agg- regate to hold downthhe dust for a long period of time under the rpt ther scattered traffic using the road.

Roadside improvement has been found to be a very necessary item in a states budget and together with relocation of trunk- lines by use of Works Progress Administration has beautified highways until the man is rare indeed who has not covered at least half of his state.

The design and construction of bridges, grade separations and similiar highway structures constitutes one of the most im- portant responsibilities of the state highway department. Most of this work is carried on as a part of the programs for high- way improvement or relocation. Occasionally, however, a bridge is replaced

is replaced independently of such a program, or with only minor approach work. In no part of highway work is planning and designing more essential than in bridge and grade separation structures These facilities are at one the longest lived, and most costly, and once built, the most difficult to improve of any part of the highway plant. Therefore, they must be designed to meet the demands made upon them through a long period of service.

An improtant new requirement which has been met in the planning and design of a number of bridges is the provision for future dual roadway construction. In certain cases bridges must be built on a concrete vertical curve and carried on piers. This is a very difficult bridge to layout, especially when used over a river

Sometimes a new bridge is demanded not only because of inadequacies in the existing structure, but to permit correction of dangerous approach alignment which condition, unfortunately, is quite frequent. A more careful planning and study of future b bridges and grade separations would be advantages in the long run due to the wastefulness necessary to replace or repair.

Sometimes in planning into the future it is found necessary to consult the War Department because of the changes which will take place in case of war. Some bridges, on rivers which are navigatable, and yet not at the present being used by ships, must necessary have a removable span which can be replaced bty a draw bridge or a lift bridge.

The so called ridgid frame bridge design is used in many cases for short spans. These bridges are either concrete

reinforced r steel beams with concrete slabs or combinations of the two steel piling sub structure are very often used with the rid-gid frame and add to the economy of design.

A very good plan to follow, in calculating the number of diff-erent types of bridges, on the various highways, which must be built, repaired, or re laced, is to allow about two thirds of the br-idgesto be built over principal routes whi e the other third will be built over secondary roads in good condition and yet allow the pro-gress of the privary rate to keep up with the modern trend of travel.

Others of the types of bridges which are in common use are the T-beam bridges and special types such as swing bridges and draw bridges. In many cases, where there are state bridges need-ed the expense of the bridge is not only partially paid by towns or cities which will use this bridge but also partially paid by pri-va e persons and cor orations which will particularly benefit through the building ofsuch a structure.

The grade separation construction program has been one of the outstanding features of the dept's work during the past seven years. This pro ram has been financed almost exclusively from Fed-eral funds and, although allotments during the last few years re-quire a slackening in construction, good progress has been made.

A substantial ortion of any grade separation program consists of projects located on state trunklines and important feeder routes in metropolitan areas.

The use of grade separation to eliminate hazards to drivers

is used in two cases or sometimes three. One of these is to allow traffic on a highway to continue to move even at a railroad crossing by either raising or lowering the highway. Another case is the use of grade separations to allow the traffic to continue without slackening speed when two highways cross. The other is sometimes a combination of the two previously mentioned. Sometimes a bridge, which crosses a road, then tracks, and then a river, serves as a grade separation. A difficult case arises when a grade speculationmust be made at a small angle over any other object but these difficulties can be overcome and land to create an interestingpproblem to the designers. These also give a certain beauty due to the oddity of the structure. The modern trend in grade separation is to hide the stiffener angles and the steel beams in concrete which is being used more and more for the natural beauty which seems to exist in such a structure.

State ferries have been used in many states and, although they are rapidly being replaced by bridges, they create a number of problems which can best be illustrated by the use of an example.

The division of Michigan into two peninsulas creates a unique state transportation situation. While several railroad ferry lines, plying Lake Michigan, carry vehicles between the two parts of the state, the problem of inter peninsula travel centers at the Straits of Mackinac where the water barrier is most narrow. Here, since 1923, the State Highway Department has operated the Michigan State Ferries.

The trans-Straits service was started with three vehicles and passenger ferries, with railroad car ferries providing winter service. The growth of the service, both to ordinary state-wide traffic and to the resort industry, is indicated by the statistics of vehicles carried and the resulting increase in the ferry fleet and facilities.

The number of vehicles transported has grown from 38,468 in the first full season of operation, 1924 to 20,243 in 1939. The comparison is somewhat distorted by the fact that in the earlier year some traffic was accommodated on railroad ferries during the winter and early spring months when state ferries were not operated. The 1939 traffic was nearly 10% in the first six months of 1940 during the last two years. This latter project is scheduled to be virtually finished in1940. In addition to providing and loading facilities for the two large ferries placed in service two years ago, ample parking areas have been built.

The steady increase in the fleet and docks, necessitated by the growth of cross-Straits traffic and particularly by the expansionof tourist travel in the region, has given impetus to the proposalfor a bridge connection between the two peninsulas. The progress made in the preliminary stages of this project by the Mackinac Straits Bridge Authority is separate from the State Highway Construction and gets through its separate facilities.

The [illegible] service was a [illegible] of the two [illegible] [illegible]

States along the Mississippi River and other large navigateble rivers must provide the necessary facilities for the crossing of these over the corresponding period in 1929, shows the trend of growth continues upward.

Pressure on facilities at the Straits is emphasized by the fact that about 48% of ferry traffic is normally concentrated in the two months, July and August. This indicates how important this Mackinac service is to the fast growing recreational industry of northern Michigan. The volumes of traval which have had to be accommodated have forced repeated additions to the ferry fleet which now numbers six vessles, five state owned and one leased.

During the biennium, work was continued to provide adequate terminal facilities for ferries. Completion of the new dock at St. Ignace was accomplished late in 1938 and expansion of accomodation at the Mackinac City dock has progressed steadily during the last two years. This latter project is scheduled to be virtually finished in 1940. In addition to providing end-loading facilities for the two large ferries placed in service two years ago, ample parking areas have been built.

The steady increase in the fleet and docks, necessitated by the growth of cross-Straits traffic and particularly by the expansion of tourist travel in this region, has given impetus to the proposal for a bridge connection between the two peninsulas. The progress made in the preliminary stages of this project by the Mackinac Straits Bridge Authority is separate from the State Highway Construction and acts through its sep-

p rate from the State Highway Construction and acts through it's separate facilities.

States along the Mississippi River and other large navigateble rivers must provide the nedessary facilities for the crossing of these rivers. In some cases the tide plays an important part in the design and construction of docks, bridges, and adjacent highways, in other cases the large floods and storms must be the deciding factors in design, but in all cases certain factors are pevailent over others and give rise to certain complications.

When first introduced, planned roadside landscaping was valued largely because it improved the appearance of the roadway But its utilitarian aspect gradually was recognized and today the regulations governing Federal Aid funds stipulate that 1½ per cent of each allotment shall be used for this purpose.

The state highways are finding that an improved road with an improved roadside landscaping attract people who wish to stop their car and see the views To accomodate these peo le the construction of roadside parks and sto ping places for cars has been found to be satisfactory. Sometimes these are constructed along mountain roads or rivers but usually just at odd points alongthe highway.

Erosion control is taken c re of by landscaping, That is, the planting of trees, shrubs, and grass.

Nothing so clearly illustrates the constant pressure on highway development by increasing traffic demand as the construction accomplishments of the past few years and the needs for further construction that now exist or are easily discernable in the near future. A period is drawing to a close in which a far-reaching and necessary program of development has been brought to virtual completion, but state highway departments are already planning ways of meeting even greater and more vital highway requirements.

Aside from what may be called the normal replacements and expansions of ordinary facilities, the need for special types of facilities is becoming more and more apparent on several parts of the highway systems. Traffic volumes on some of the major industrial trunklines are so large that it is plain more widening of ordinary pavements to accomodate over-all traffic growth will never adequately meet the demands.

Further reduction in the mileage of gravel surface rural trunklines and general replacement and improvement of facilities will go on. At the same time, it is probable that during the coming years the need for meeting requirements in critical sections will be emphasized as the national defense program gains momentum. For that reason, it seems reasonable to expect that highway construction is entering a new phase in which more highly specialized problems of highway transportation than in the past.

SAMPLE LETTER NO. 2

State Highway Dep't

Gentlemen:

I am a Senior Civil Engineer at Michigan State College located at East, Lansing Michigan. As there is very little up to date literature available upon Highway Administration I am writing to ask you to give me a line-up on you highway or road government system.

Since I realize that your time is valuable I would very much appreciate your slightest assistance.

Yours Sincerely,

Samuel W. Bair

1134 West Washtenaw

Lansing, Michigan

SAMPLE LETTER NO. 2

1134 West Washtenaw Street
Lansing, Michigan
United States of America
February 15, 1941

Road government of Highway Administration
Republic of French Guiana
South America

Gentlemen:

I am a Senior Civil Engineering student at the Michigan State College, located at East Lansing, Michigan. It is required of all graduating Seniors that they leave some sort of projedt that will be useful to future college students. As I am writing a book on highway or road government, I am writing to you for information upon your road and bridge construction and administration.

As I realize that your time is valuable and since my request is a difficult one to comply with, I would certainly appreciate your slightest assistance.

Yours Sincerely

Kenneth H. Bair

ENGINEERING MATERIAL and TESTS employed in HIGHWAY MAINTENANCE.

Most states now have departments whose functions are the testing and research of materials used by their highway departments in road construction and maintenance.

The major part of the inspection of the large variety and enormous quantities of materials used in highway constructions and maintanence is performed in the laboratory. The work performed in these laboratories includes the investigation of methods of tests, the testing of samples, taken in the course of developing new material sources, the preparation of standard and special specifications, and the conduct of research and investigational work.

The classification of the types of tests preforms in these laboratorys are: preliminary tests-those made in advance of the use of a material to obtain information as to its suitability for a particular purpose. The fact that a material is shown to be satisfactory by a preliminary test does not guarantee acception of future shipments of the same material from the sourses investigated.

(2) Acception tests are made for the express purpose of accepting or rejecting the material actually offered by a constractor for use on the work. Samples for acceptance purposes are taken at the material plants or warehouses before shipment is made, or after the delivery of the work. (2) Check tests-those made on materials that have been in storage for a sufficient length of time to cast doubt upon the quality;

on materials which are of such nature that they might deteriorate in storage, those which have been in storage under such conditions as to cause deterioration, and those which do not appear to be satisfactory after receipt at the site of work.

(4) Quality tests- those made to secure information as to the suitability of a specific material for a certain purpose and to develop methods of tests which may later be used as the basis for accepting or rejecting.

Plant inspection: If the volume of work, the nature of the materials and other considerations warrant, inspection is performed at the source of supply; only when the cooperation of the contractor and material producer is accused. Experience has shown that efficient plant inspection provides better control of quality, expedites the work in the field by preventing delays the rejection being the cause, and reduces the cost somewhat by lessening the operating cost of the producer.

The following paragraphs summarize a few of the facts relating to plant inspection A-aggregates which include crushed rock as well as natural sand and gravel are inspected at the local plants. Materials for a single job are taken from a single deposits so as to simplify inspection tests for aggregate include gradations percentage of freshly crushed material erosion characteristics.

B- Bituminous materials such as asphaltors and oils used for maintenance purposes are purchased in large quantities and inspected at the plants before shipment. Tests for these materials

include flash prints, viscosities, distillation, ductilities and penatrations.

c- Bituminous mixtures including oil aggregates, asphalts, and patching mixture are purchased in a considerable quantity for maintenance. In inspecting materials of this kind, the ingredient materials of this kind the ingredient materials are first tested in the laboratory; upon their approvable, an inspector is sent to the plant to see that the inspected materials are used, verify the correctness of the proportions, and supervise the manufacture of the mixture. Tests for bituminous mixtures should include bitumen determination, gradation of aggregates contained therein and moisture determination.

B- Brick and Blocks

This group includes paving brick, masonry brick and granite blocks. Paving brick used are of the vertical fiber long type and are used as the name implies, masonry brick are used mostly in the construction of manholes and catch basins. Absorbtion tests compressive strength and transverse strength testsaare made on these brick in the laboratory and they are given a visual inspection at the plants to cull out defective brick before shipment. Granite blocks are used in paving between car tracks in city paveing. Hardness and toughens tests are are made on these blocks in the laboratory, and they inspected visually at the site of work. Cement purchases as a rule, thru contractors is inspected at the mills and checked for weight on the job, the contractor being held responsible for satisfactory delivery of the cement.

Curing and setting tests are given the cement.

Corrugated metal pipe is inspected at the plant to insure satisfactory material and workmanship. Laboratory tests are made to determine the extent of galvanization.

Highway markers and signs used on both new roads and for replacement for the entire primary system are purchased directly from manufactures and are inspected at the plant during the fabrications.

Labortary tests on these signs include heating and freezing cycles and wethering by corrosive atmosphere and ultra violet ray.

Paint used in constructors work is usually purchased as needed with a small amount being stocked for shipment to the various construction jobs. It is used mostly on steel bridges although some is required for fierce construction. The manufacture of paint is very carefully inspected. Before a manufactor is permited to start actual formulation, he is required to have all the inredient materials on hand. These are sampled and identified by a representative and tested in the laboratory for compliance with the specifications. After they are found to be satisfactory the manufacturer is permited to proceed with the formulation of the paint, an an inspector is placed in the plant to supervise the manufacturing process. Final acception is based on tests made on samples taken after the arrival of the paint at the laboratories.

Pipe and tile are practically all accepted at the manufactures plant. Structual clay tile are used in construction and

sidewalks on bridge floors. Concrete pipe and tile, vitrified pipe, and ordinary drain pipe are used for the construction of culverts, sewers and general drainage purposes. Most tile manufacturers have at their plants equipment for making strength tests. Where there is insufficient equipment at the plant samples are sent to the state testing laboratories.

Metal products include such materials as structual steel, reinforcement bars, wire mesh reinforcements, castings, and other miscellaneous metal products. Most of these are inspected at the plants.

In general, lumber and piling originate either in the southern part of the United States or on the west coast. Most of it is used in construction of guard fence, although some is used in structures. The most satisfactory method is to maintain inspectors at the source of the material or rely on the inspection that can be obtained through reasonable that can be obtained through reasonable lumber associations such as the Southern Pine Association and the West Coast Lumbermens Association. Associations of this type maintain dependable inspection organization.

Inspections are made on a large amount of miscellaneous materials, among which maybe mentioned segmental concrete blocks for catch-basins and manholes, concrete inlets and outlets, concrete curvings, concrete section markers and concrete right of way markers.

The above materials covered were mentioned with respect to prelimary inspections. A practice employed to quite an extent now is that of subjecting the finished products to physical

tests by which means it is possible to maintain proper standard and predict the durability of the product. For example cores are cut from new concrete pavements for the purpose of checking the thickness of the slab. These slabs are also tested for compressive strength.

Many other tests are preformed by the materials testing department of the various states, what the aboved mentioned are of most important and constitute the major portion of these departments work.

STATE HIGHWAY DEPARTMENT FINANCE and the FEDERAL AID

APPROPRIATIONS

In order to provide satisfactory highway service, any plan of highway finance developed involves two equally important considerations, first, the source and amount of income produce, and second, the disposition or application of the income. In most cases it will be found that the income available is not enought to meet the needs of a good highway department. Most states are beginning to fall back on or rely on the federal government aids. This, in itself, is an unsatisfactory condition because it will become worse and worse at long as the federal government continues to help. When, in the future, this aid is withdrawn, we will find that our state highways departments will begin to collapse and in this way the after war depression will hurt our wonderful highways. In order to relieve any condition of unstability the highway departments are getting together and discussing the best methods of accounting. This includes the distribution of income and expenditures and involves a closely checked budget. The highway department makes a great effort to follow this budget closely.

Expenditures are not only classified according to the various types of expenses but are also classified according to districts, sections, or countries.

Another important feature in the highway departments operations is that of equipment rental charges. Studies have been

made where by predetermined charges for the use of all equipment can be made so as to provide a reserve, or sinking fund, for the purchase of new equipment when the old becomes obsolete or worn out. There is an imperative need for the adequate capitalization of this account so that many pieces of equipment now in use that have exceeded their economic life can be replaced. Careful studies indicate that a large amount of money will be required for the proper capitalization of the equipment account, and while it is impossible to achieve this result at one time due to the volume and variety of other demands that are made on the maintenance account, an effort should be made to set up this large amount over an extended period of time.

Another item which should be brought to the attention of one interested in highway administration is the purchasing of materials and equipment through a central office in order to save through buying large quantities. The materials thus bought are requisitioned out to the various departments and the various sections according to their immediate work and needs.

Income for State highway purposes includes the revenue derived from State imposed taxes which consist principally of motor vehicle imposts, and Federal Aid of various types and classes.

Revenues derived from State sources for highway purposes

1. Motor fuel taxes

2. Motor vehicle registration fees

3. Auto division fees

4. Drivers license fees

5. Oil inspection fees

6. Auto in-transit fees

There are various other miscellaneous receipts from sales, interest and testing charges, plus an apportionment for the state police fund from all imposts collected by the state revenue department.

Regular Federal Aid appropriations must be matched with state funds unless otherwise provided by law. Since many states were laboring under financial difficulties, Congress in 1932 made an emergency appropriation of $120,000,000 to be used by the several states in lieu of an equal amount of state funds to match Federal Aid funds. In this manner the states were enabled to take advantages of the 1933 Federal Aid allotment. No appropriations of regular Federal Aid were made for the fiscal year 1934-1935. Appropriations for the fiscal years 1936 to 1939 inclusive, were made available without the requirement of matching with state funds provided that the proceeds of all special tax on motor vehicle transportation collected by a State were applied to highway purposes for which such proceeds were previously pledged. The Federal Toll Bridge Act, Public No. 286-75th Congress as amended, Public No. 195-76 Congress, also offered to aid the State under certain conditions. These conditions were that all State-owned toll bridges be freed of toll. Only this action could establish the states eligibility to participate in the benefits of the Federal Act whereby credits representing fifty

percent of the cost or value of these bridges, where located on the Federal Aid System, could be used for matching problems of Federal Aid and Federal Aid Secondary funds up to one-half the allotments. Only under these conditions are states qualified for the Federal Aid allotments.

In addition to the regular Federal Aid appropriations Congress has also made appropriations in the form of grants for highway construction and for the elimination of hazards to life at railroad-highway grade crossing during the period from 1933 through 1941. For the fiscal years 1938 through 1941 Congress also authorized appropriations for the construction of secondary or feeder roads which are not on the Federal Aid system of roads nor potential additions thereto.