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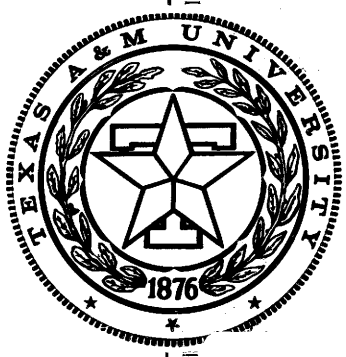

TEXAS
TRANSPORTATION
INSTITUTE

TEXAS
HIGHWAY
DEPARTMENT

COOPERATIVE
RESEARCH

DEVELOPMENT OF MAINTENANCE METHODS AND COST CODES

in cooperation with the
Department of Transportation
Federal Highway Administration

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STUDY 2-18-71-151
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16. Abstract

Close cooperation among Texas Highway Department district maintenance operational personnel, central office representatives and the Texas Transportation Institute study team together with a review of the literature provided the necessary information to formulate a list of maintenance activities and to develop maintenance methods and cost codes. The major information presented in the maintenance methods as developed is discussed. A listing of cost codes and the key elements of a maintenance management system are presented.

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DEVELOPMENT OF MAINTENANCE METHODS AND COST CODES

by

Jon A. Epps, Irl E. Larrimore, Jr., R. M. Olson and A. H. Meyer

Research Report 151-1

Maintenance Quality, Methods and Ratings

Research Study No. 2-18-71-151

Sponsored by

The Texas Highway Department
In Cooperation with the
U. S. Department of Transportation
Federal Highway Administration

July, 1974

TEXAS TRANSPORTATION INSTITUTE
Texas A&M University
College Station, Texas

PREFACE

This is the first report issued under Research Study 2-18-71-151, "Maintenance Quality, Methods and Ratings". This report presents a review of the development of maintenance methods and cost codes suggested for use by the Texas Highway Department. Details of the development of the maintenance rating system and maintenance management programs are contained in separate reports.

DISCLAIMER

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to the Texas Highway Department personnel in all 25 districts as well as representatives from divisions D-10, D-13, D-18 and D-19 for their time and efforts expended in defining current maintenance methods and activities, review of these methods and guidance in preparing the type of information necessary for effective management of the Texas Highway Department maintenance operations.

ABSTRACT

Close cooperation among Texas Highway Department district maintenance operational personnel, central office representatives and the Texas Transportation Institute study team together with a review of the literature provided the necessary information to formulate a list of maintenance activities and to develop maintenance methods and cost codes. The major information presented in the maintenance methods as developed is discussed. A listing of cost codes and the key elements of a maintenance management system are presented.

KEY WORDS: Maintenance methods, cost codes, management, equipment, materials.

SUMMARY

The basic elements of a maintenance management system have been recognized and defined. These elements include the establishment of maintenance methods, quality standards, evaluation methods, cost codes, maintenance strategy, training, data feedback and trial implementation. This report delineates the development of maintenance methods and cost codes by establishing panels consisting of Texas Highway Department district maintenance personnel, central office personnel, and members of the Texas Transportation Institute.

The establishment of maintenance methods and cost codes form the basis for the further development of the maintenance management system. The establishment of permanent panels to review, revise, and develop new methods should be considered together with the establishment of a management and training section within the maintenance operations division. This appears appropriate to implement the results of the study.

IMPLEMENTATION STATEMENT

The maintenance methods and cost codes developed as part of this study and reported herein are either scheduled for implementation or are being implemented.

Implementation of the maintenance method is widespread, as the methods developed are employed in on-going activities. Implementation of these methods and cost codes are expected to improve efficiency and provide for more uniform maintenance activities throughout the state.

The establishment of training activities based in part on the maintenance methods and cost codes should be organized to provide maximum

benefit to the operational personnel.

The establishment of permanent review panels composed of district maintenance operational personnel and the establishment of a section within the maintenance operations division may be necessary to successfully carry out the task of continued review of the methods and codes.

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INTRODUCTION

Funding for highway maintenance operations in Texas comprises a significant part of the total highway budget. The proportion of the budget is expected to increase as the amount of new construction is reduced and as the highways now in existence become older. This together with public demands for higher and higher levels of service are certain to increase maintenance expenditures. This trend is evident from data presented in Table 1, and in Figure 1 (1).

The Texas Highway Department has a system of maintenance which is managed in each district, the maintenance operations division in Austin provides guidelines and support in the form of manuals and consulting services. That the present system is functioning well is attested to by the excellent condition in which the highways are maintained. Periodic review of maintenance operations in the state are provided when maintenance personnel from the districts meet annually in 3 to 4 groups to discuss mutual problems and successes. These discussions often lead to ways and means to meet current or recurring problems. Areas identified from the meetings include training of maintenance personnel and the necessity of improved maintenance management information. Training needs are based on the desire to improve quality and quantity of work as well as developing the necessary skills in new maintenance employees. The need for improved management information is based on anticipated increased work load, as well as monitoring existing operations and providing information for future work scheduling.

In an attempt to respond to these needs, the Texas Highway Department initiated a cooperative research study with the Texas Transportation

Institute in September of 1970 with the following objectives:

1. Develop a system by which all highway maintenance operations can be coded and placed into functional groups.
2. Develop maintenance quality standards and maintenance methods for the various highway classes.
3. Develop a maintenance rating system that can be used as a basis to schedule highway maintenance operations.
4. Implement on a trial basis the maintenance rating system and assess the established quality standards and maintenance methods.

STUDY APPROACH

To provide for close cooperation between the Texas Highway Department and the Texas Transportation Institute, considered necessary for successful completion of the study, three means of formal contact were established:

1. A study contact man representing the maintenance operations division of the Texas Highway Department was appointed to devote approximately one-half time to the study. This individual has remained the same for the duration of the project and maintained contact with both the study supervisors at the Texas Transportation Institute and Texas Highway Department district personnel.
2. Study panels were established to identify maintenance activities, develop maintenance methods, and to define the type of information that would be useful for maintenance management purposes. These panels were comprised of district supervisory maintenance personnel from each of the districts.
3. An advisory group was formed consisting of representatives of the Texas Highway Department concerned with design, materials and tests, research and maintenance, representatives of the Federal Highway Administration and representatives of the Texas Transportation Institute. The purpose of this group was to furnish overall guidance to the project.

Formal meetings, together with informal contacts made while traveling and after meetings established lines of personal communication between the study supervisors, maintenance operations division contact representative, and the district maintenance personnel. Understanding and acceptance of the information developed in the project was thus greatly enhanced.

Study panels, as will be discussed below, formed the working element of this study. These panels were responsible for identifying the types of maintenance activities currently performed by the Texas Highway Department, for preparing the maintenance methods and for guidance in selecting the appropriate approach to the maintenance evaluation portion of the project.

This report discusses the development of the first two objectives, namely the development of a system by which all highway maintenance operations can be coded and placed into functional groups, and, secondly, the development of maintenance methods. The coding of the maintenance activities, hereafter referred to as cost codes, was developed concurrently with the maintenance methods. After a list of maintenance activities was developed, a systematic code was developed together with a definition of the method to perform this activity. Maintenance methods are commonly referred to as work standards in studies conducted in other states.

A review of literature pertinent to maintenance management has been accomplished in this study. Basic ideas developed for management, and current state practices relative to maintenance management are discussed, as are the procedures utilized to develop the maintenance methods and cost accounting codes suggested for use by the Texas Highway Department.

Importance of Maintenance Management

Francis C. Turner, formerly Director of Public Roads (FHWA), discussed "Maintenance Requirements for the '70's" at a Maintenance Management Workshop held at the Ohio State University in July 1968.[2] He quoted estimates of cost of maintaining the completed Interstate System at $6,400 per year per centerline mile and noted that the report conceded the figure is "probably conservative" and ". . . . . it is likely that $10,000 per centerline mile will be a more realistic estimate for the overall mileage".

We have 3,025 miles of Interstate Highways in Texas, at $10,000 per mile per year this represents an annual predicted expenditure of $30,250,000 for maintaining the system. Add to this the annual cost for maintaining the other primary and secondary highways in Texas, and the importance of maintenance management becomes clear as follows:

P. J. F. Wingate, of the Road Research Laboratory (England) concluded his report to the Maintenance Management Workshop.

> *"To sum up, in Great Britain we must start logically by getting the maintenance task right, i. e., by setting our standards correctly. Then we must get our administration and organization right so that we know what is going on and so that planning and controlling are done correctly. Finally, we must insure that what is to be done on site is done in the most efficient manner. All three of these aims can and are being pursued simultaneously of course, but the emphasis we feel should be placed in the order given - it is false economy to carry out efficiently work that should not be done at all!"*

The last phrase bears further consideration. It appears to be a truism, but it also suggests that tasks assigned by managers should be

responsive to the objectives of the organization, and not merely busy work.

Goals of Maintenance Management

Maintenance funds are obtained from the public and accountability for the expenditure of these funds is a primary concern of highway administrators at all levels. Thus, while the maintenance foreman is fully aware of the work he accomplishes on a day-to-day basis, his superiors must evaluate the performance of the maintenance team as a whole and keep records on the expenditure of funds. A management system is required and its importance grows in proportion to the amount of money involved in the operation.

The importance of maintenance management has been established in the preceeding paragraphs. The goals of the management system can now be listed:

1. The mission of the highway department must be achieved.
2. Maintenance work accomplished must be necessary to achieve the mission.
3. The amount and quality of work is adequate to meet the needs of the user.
4. Accountability for expenditure of funds must be established and maintained.

These goals although common to all agencies in a general nature are implemented in a variety of ways. A review of state practices will indicate some of the differences.

SURVEY OF SEVERAL STATE HIGHWAY DEPARTMENTS

In December 1971, letters were sent to eleven states requesting information concerning maintenance methods programs. Replies were received from each state, and each state, except North Carolina, sent copies of its standards. The results are summarized in Table 2, and a synopsis of responses from the several highway departments is presented in the following paragraphs, as is additional information which has been obtained from published reports and by other correspondence with highway departments.

Arizona Highway Maintenance Management System

A 24-month research study began in June 1970 and a report (3) was submitted to the highway department in June 1972. The project staff was composed of state and consulting personnel. Review of maintenance standards and procedures was undertaken by a committee. An advisory committee reviewed project progress and provided guidance. Upon completion of the study, the state personnel continued in the maintenance planning functions and the reviewing process. A maintenance management system was developed and results of the system observation were evaluated during a 12-month test period. The report indicates that operating costs were reduced and service level was increased.

Principal system elements included: roadway inventory, quantity and performance standards, work programs and authorization, scheduling, reporting budgeting and evaluation of performance of field units. The report contains examples of forms and techniques developed during the study.

ARKANSAS

A maintenance management research project was begun in 1968, and became operational on January 1, 1972. A manual on maintenance scheduling and reporting aids the maintenance man in the field with work scheduling, management tools, crew schedules, and reporting cards. Thirty-two activity codes are employed and work performance standards define each activity. Information describing a condition needing maintenance, procedure for work to be accomplished, men and equipment required and estimates of daily production are contained in each standard.

California Maintenance Management System

Nineteen maintenance work programs have been established and coded with further classifications for sub-program, activity, standard method, and support activity. An example code includes:

01	Program: Flexible Roadbed
-2	Sub-Program: Surfacing and Patching
-1	Activity: Hand Placed
-1	Standard Method: Pothole
-21	Support Acitvity: Travel Time

Work standards have been developed for 196 of 361 defined work methods. Scheduling values have been prepared for the remiining work methods; these values are based on historical estimates, performance reporting, work studies, or a combination of these sources. Scheduling values are replaced by work standards as the latter become available.

Illinois Maintenance Management System

The primary objective of this management system is to produce reliable cost and accomplishment data which are to be used in reports to produce a flow of information to the several supervisory and administrative levels. The field reporting was initiated July 1, 1967 when collection and recording

of cost data became a computerized process. Several months of preparation were required before the change was made. New forms and procedures were prepared, and personnel training was required to change from a manual operation in the 10 districts to the central computerized operation. Changes in field operations were also established in January 1970; foremen are expected to participate in the work.

An essential feature of the system is a roadway inventory, which includes lane miles of roadway pavement, acres of mowing, lengths of bridges, miles of ditches, and other items of work. The inventory compares potential work load, and in conjunction with costs will become the basis for performance budgeting. Several reports are generated by the system, but simplicity in field reports is an important consideration. Each district has a remote terminal tied into the central computer.

Development of performance standards is a function of maintenance personnel from the various geographical areas of the state and several supervisory levels. Fifteen standards are in use, and others are being developed.

Louisiana Maintenance Standards

Louisiana originally developed 115 functions, and trimmed these to 92 in 1971, further trimming to 85 functions is under consideration. Quality standards have been established for 30 functions, and accomplishment reporting is required on several other functions. Quality standards have been developed, and in conjunction with unit costs an anuual work plan is prepared which is the basis for the budget.

An interesting feature of some of the standards is the use of photographs for illustrating conditions requiring maintenance. A description of what causes the condition, the need for repair and how to make repair is contained in the standard; as are helpful hints to the field man.

Minnesota Maintenance Standards Field Manual

The purpose of the manual is to assist management in work scheduling, planning and budgeting. Minnesota law requires all state departments to budget by activity and the manual is designed to assist in the budgeting procedure. The manual is not a rigid management policy, but is a guide to indicate the best rate of production based on crew production studies, audits or work reported and the concensus of the Field Productivity Standards Committee.

Forty-three maintenance operations are coded in five classes: routine, special, extraordinary, betterment and non-roadway. Operations in the field are supervised by a working member of the crew. Emphasis is placed on standard crew size, because studies indicate that productive crew size is one of the most important factors in efficient operations.

New Jersey Maintenance Work Standards

The work standards contain 133 function codes and descriptions, each of which contains the payment unit (hour, square yard, etc.), the basic crew, work factors hours per unit, and units per hour. Equipment, material and tools required for each function is listed on each standard. New Jersey has a Safety Manual, and each standard contains a note which states that safety practices must conform with the Safety Manual.

Oregon Maintenance Management System

Mr. Tom Edwards, Deputy State Highway Engineer, reported to an HRB meeting at Austin, Texas in August 1971 that:

"Oregon's Maintenance Management System is based upon a numerical recording of data which adapts itself admirably to computerized control."

Maintenance and minor betterments are coded into twenty-one activities, or items of work. These code numbers are tied into the county and control numbers, which provides for charging of labor and materials to the proper section of the highway. Equipment is given a fleet code number and daily rental rates are charged to the appropriate highway section. Reports are submitted to the central staff and budget control is established.

South Dakota Maintenance Functions, Quality Standards, and Productivity Standards

A maintenance study began in July 1968 and was implemented in July 1, 1971. The manual contains 77 function codes, 17 productivity standards, and 21 performance standards. Equipment, manpower, daily production and average unit costs are provided; as are descriptions, purpose, quality of work, scheduling and procedures for performance. Productivity and performance standards are to be developed for all function codes.

Tennessee Maintenance Management Improvement Program

A management research study (4) was completed in January 1970. Review of costs records and distribution of expenditures for twenty function codes was conducted. Work performance by crews and organizational structure was examined. Examples of maintenance activities in a program, performance standards, costs budgets and comparisons of illustrative budgets with actual 1969 expenditures are presented in the report.

Utah Maintenance Management System

A twenty-eight-month research study was completed in September 1969, and the final report (5) contained the results of the study which was prepared by the project staff consisting of highway and management consulting personnel. An advisory committee and a maintenance standards panel worked actively

during the course of the research effort. The management system elements consist of: standards and planning values, work program and performance budget, procedures for planning, scheduling, and performing work, work reporting system, and performance evaluation.

A Foreman's Handbook is used as a guide for performance of maintenance work. Approximately forty activities are defined, and standards have been developed for each activity. Reports on progress are made on a Period Activity Record Form, on which daily entries are made by the foreman.

Virginia Maintenance Program

Fourteen ordinary maintenance activities are coded for purpose of preserving each facility as near as possible in its condition as constructed. Eight maintenance replacement activities are coded for the purpose of restoring of facilities where such restoration becomes necessary.

Maintenance training material is available for some activities and is being prepared for other activities; methods and crew size are included in these training guides.

Washington Maintenance Work Control System

A Time Standards Manual was developed for daily use by field supervisors. Each standard defines the amount of time required to complete a unit of work, personnel and equipment requirements, purpose, procedures and special considerations. Planning of work and consistency in activity evaluation are provided by the standards. The manual contains ninety coded operations which were developed from extensive studies in the field and revised when necessary from historical data maintained by computer.

Interim standards are employed in the field, but are subject to revision.

Another type of manual is used to disseminate information not covered by time standards. These manuals are concerned with new processes, or a field of related operations; and are intended for use in the field as guidelines for training as well as performing work.

A third manual on Quality Standards provides criteria for the maintenance work control system. Description of maintenance activities is employed rather than a measured value. The quality standards provide guidance to a supervisor for evaluating work accomplishments.

SUMMARY OF LITERATURE

Based on the above literature review it appears that several basic elements are necessary for a successful maintenance management program.

1. Methods for performing individual maintenance activities should be established. These methods provide the manager with a clear, concise statement of the method by which his forces are to proceed to accomplish a selected activity. These methods should be under constant review and provision should be made to perform this continuing task.
2. Standards of quality should be established. The maintenance methods described in the guidelines discussed in item (1) may require a variety of quality control. For example, the standard for an Interstate Highway will require higher quality than that for a lightly traveled farm or ranch road. The proper amount of work and quality of that work can be determined by the standard established for the task.
3. An inventory control should be established. In whatever form

it might take, it is clear that the manager at whatever level should have an inventory of the traveled way and its appurtenances.

4. Evaluation of the maintenance operation described by its method and controlled by the standard of quality should be a function of the management system. Such continuing evaluation will provide the manager with a clear indication of how well the funds are being expended. It will also permit re-evaluation of the standards, and will determine how effectively the task is being done on the job. Where productivity is lagging, newer methods and techniques may need to be established to reduce expenditures.
5. Priorities for scheduling improvement should be developed. This element of a management system will require firm control by the manager, lest he and his operation find themselves carrying out " . . . efficiently work that should not be done at all'."
6. A cost accounting method should be established. This element, like inventory control, is a bookkeeping method. Here, however, it is the dollars and cents history of what has been accomplished, and the basis for making estimates for future maintenance. Inventory control and cost accounting can become the be-all and end-all of any management process; unless the manager recognizes that these two functions are the servants not the dictators of the management system. The manager must be ever cognizant of the goals of the system, of which accountability is one quarter of the overall goal. The other three-quarters being the mission of the highway department in making necessary maintenance repairs and improvements to meet the needs of the user

through appropriate standards of quality.

7. A maintenance strategy should be established. This element is needed to coalesce the other elements into meaningful, cost-effective, user oriented effort. The success or failure of a strategy is dependent upon the tactics employed to achieve the goals of the planned tactical efforts. In the history of warfare, many great tactical victories have been won, but strategical failures have led to losing the war. Conversely, great strategies without adequate tactics can produce defeat. Thus, the manager must have both strategy and tactics at his command.

   In small operations the several elements (or tactics) make up the strategy. In large operations the manager must employ a strategy which is consistent with the other elements of the management system. Decision making can be at the upper echelons of a system, it can be centralized; or it can be delegated to the level appropriate to the task function. Probably the most onerous chore for the manager is selecting the strategy which will best fit the goals of the organization.

8. Maintenance training should be a part of the system. The training must be a continuing effort and centered not only on the engineering aspects as defined by the maintenance methods and evaluation techniques but also it must be concerned with management principles and utilization of information provided by the management system.

9. The establishment of a data bank capable of providing needed information for management purposes as well as accounting

purposes is necessary. This data bank must be easily accessible and have the capability of providing information in a time frame compatible with the need for the information at several levels in the decision making process.

10. A period of trial implementation is desirable during the development of new methods. New evaluation techniques and the utilization of management feedback information can be appraised during this trial period.

DEVELOPMENT OF COST CODE AND MAINTENANCE METHODS

Initial work on the study concerned development of methods to classify maintenance activities. A review of the literature previously cited produced data shown in Table 3. Based on the table and discussions with Texas Highway Department Maintenance Operations Division personnel five major areas were identif for the purpose of establishing study panels. These panels were formed during the first 6 months of the project and were composed of district personnel, representatives of the maintenance division and the Texas Transportation Institute. The panels and their respective areas of responsibility were:

PANEL A - Base and Subgrade

PANEL B - Bituminous Surfaces and Shoulders and Approaches

PANEL C - Portland Cement Concrete Surfaces

PANEL D - Roadside Maintenance

PANEL E - Structures

The original members of the panels are shown in Table 4. These panels have remained active during the project although the composition of the panels have changed due to retirements and promotions. The existing composition of the panels is shown in Table 5.

As noted in Tables 4 and 5 each district was represented with a meeting held as required at the various district offices located throughout the state. The first round of panel meetings was held to describe the objectives of the study, to identify existing maintenance operations and to assign responsibility for development of the maintenance methods. Subsequent meetings were held to review the developed methods, assign responsibility for developing additional methods, and to initiate action on the development of the maintenance evaluation techniques. A total of 5 rounds of panel meetings have been held to develop in excess of 200 maintenance activities currently performed by Texas Highway Department maintenance forces.

Maintenance Method

A typical example of a maintenance method developed by the panel is shown in Plate 1. The major information provided in the method is described below.

Identification. This top portion of the method gives the title and the cost code number.

Definition. This section defines the activity that is described below. The conditions favoring use are stated to provide guidance in terms of traffic, size, extent, or other conditions that would favor the use of this method over some other method. The procedure defines a step by step method for accomplishing the maintenance activity together with the necessary men, equipment, materials, and small tools necessary for proper performance of the activity.

Performance Data, Quantitative. This section of the method is intended to give the reader an indication of the cost and production that can be expected by use of the method under average conditions. The cost data were

obtained from one or more districts by use of a form shown in Plate 2.

Performance Quality Standard and Method of Rating. This item indicates in a very general way the level to which the maintenance activity should be performed and the method to make this evaluation.

Scheduling. This section provides a delineation of the time of year or under what conditions the activity should be performed.

Comments. Alternative types of materials, new equipment and potential problems are often included in the section.

Cross References. The reader is provided with code numbers of other methods that pertain to use of the method being described.

Cost Codes

Parallel to the development of maintenance methods, coding of the methods for cost accounting purposes was studied. Results of this study are shown in Appendix A. Seven maintenance categories were established as shown below:

100	Base and Subgrade
200	Surfaces
400	Shoulders and Approaches
500	Roadside Maintenance
600	Structures over 20 Feet
700	Traffic Surfaces
800	Extraordinary Maintenance

Subgroups were defined in each of the seven categories, and the subgroups were further subdivided, as required. For example item 521 identifies a roadside maintenance activity - "litter pick-up by hand". The first digit indicates a 500 series activity which is reserved for roadside maintenance. The 520 series represents litter pick-up and the particular item 521 indicates that litter is removed by hand. Items 522 and 523 refer to litter pick-up by a "tow type" of machine and by a "self-propelled machine with shredder" respectively.

As noted from the above example these function codes can be utilized to compare alternative methods of performing the same basic activity such as litter pick-up. It is anticipated that this type of information will be helpful in establishing the type of action that is required under a given set of conditions. This three digit system will be implemented in September of 1975.

DISCUSSION

The formation of cost codes and maintenance methods form the background necessary for the development of an improved maintenance management system. Continued revisions of the methods established, deletion of certain methods and the addition of methods will be necessary in the future. The establishment of permanent panels composed of district operational personnel and the establishment of a section within the maintenance operation division may be necessary to successfully carry out the task.

Performance quality standards which comprise part of the maintenance method need to be improved and quantified where possible. Development of the maintenance rating system should provide a valuable input to the need.

A continuous collection of performance data with feedback to the

working panels is necessary. The rapid rate of inflation together with the need to evaluate existing standards makes this an important item.

The establishment of training activities based on the maintenance methods, cost codes and evaluation techniques, and management principles should be organized to provide maximum benefit to the operational personnel. These training activities should lead to rapid implementation of all phases of the study.

Implementation of the results discussed in this report is widespread, as the methods developed in the study are used in on-going activities. Exchange of ideas through these methods is evident. The cost codes will be implemented in September of 1975.

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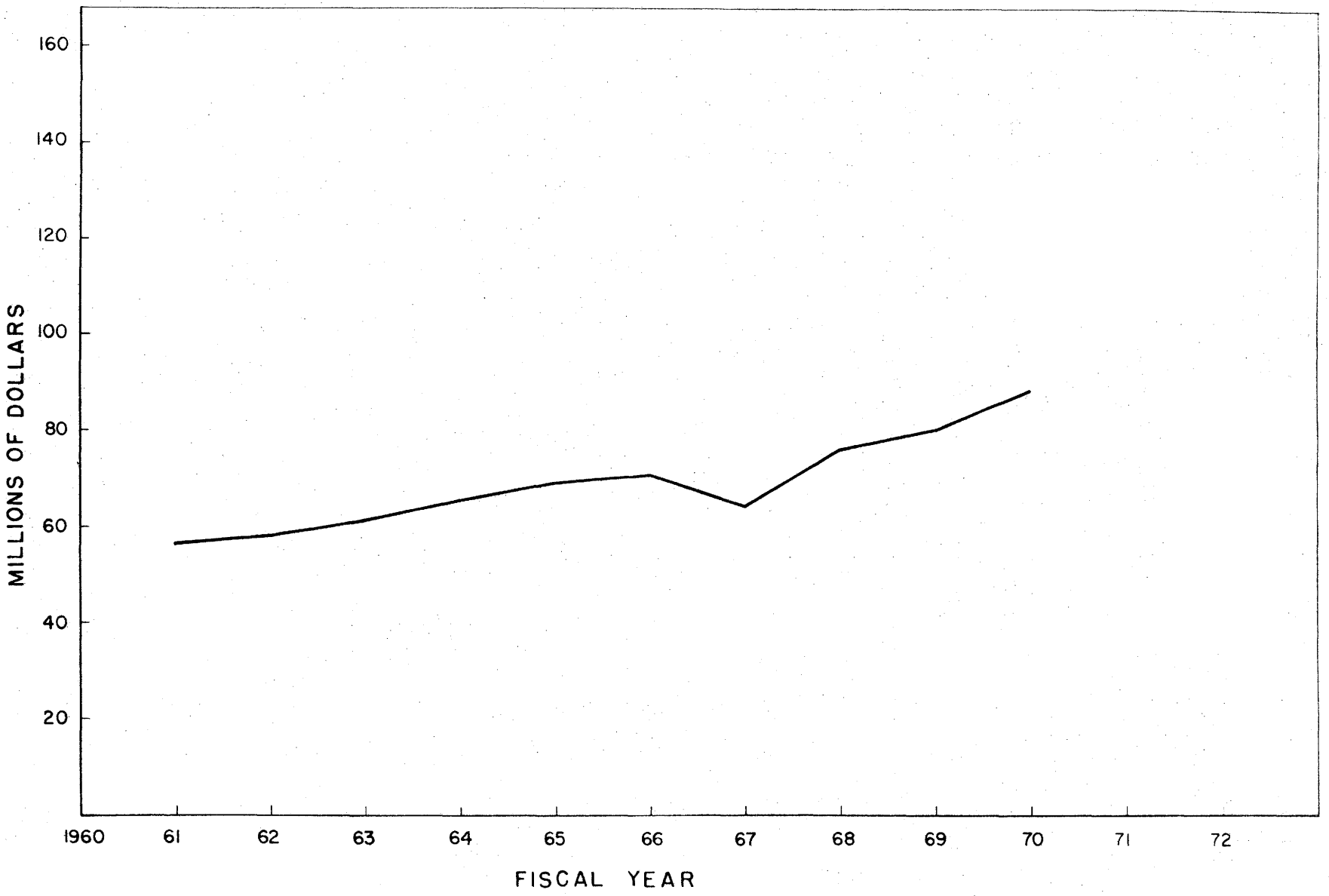

Figure 1. Maintenance Expenditures in Texas 1960 Through 1970. [After Reference (1).]

PLATE 1: Typical Maintenance Method

TEXAS HIGHWAY DEPARTMENT ------ MAINTENANCE ACTIVITY

REPAIR OF POT HOLES

Temporary

Cost Code
262

DEFINITION

The temporary repair of bowl-shaped holes of various sizes in an asphalt pavement.

METHOD

Conditions Favoring Use

The temporary method of repair should be used anytime that the permanent method cannot be, such as adverse weather conditions, traffic too heavy, etc.

Procedure

1. Provide adequate traffic control.
2. Remove water and loose material from the hole.
3. Backfill the hole with one of the following types of material:
   a. Base material or crushed gravel.
   b. Base material and an asphaltic concrete material.
   c. Asphaltic concrete material.
   d. In case of a submerged hole, asphaltic concrete material in burlap bag.
4. Compact the patch as well as possible by hand operated equipment or truck wheel.

Men

3 Crewmen with capability of operating truck and placing asphaltic concrete material. Flagmen as needed.

Equipment

Truck
Signs and Barricades as required

Small Tools

Asphalt rake
Broom
Hand Tamp

Materials

Base material
Asphaltic concrete material

PLATE 1: Typical Maintenance Method (Continued)

PERFORMANCE DATA, QUANTITATIVE — Unit of Measure -- Cubic Yard

Unit Cost Labor	Unit Cost Traffic Control
Unit Cost Preparation	Total Unit Cost
Unit Cost Travel	Labor Required Hours/Unit (Net)
Unit Cost Equipment	Labor Required Hours/Unit (Gross)
Unit Cost Materials	Approximate Accomplishment Per day

PERFORMANCE QUALITY STANDARD

Provide a reasonably smooth and safe riding surface until permanent repairs can be completed.

METHOD OF RATING

1. Test ride the repaired surface at designated speed limit to insure smoothness.
2. Make a visual inspection to insure that a neat appearing surface which adequately prevents surface water from passing into the base or subgrade is produced.

SCHEDULING

Temporary repairs may be performed at any time as needed.

COMMENTS

1. During wet weather cement may be added to the asphalt patching material and around the exposed surfaces of pot holes to add stability to the patch.
2. An infrared heater, butane burner, or other system may be used for drying the hole and patch.
3. An "Ejecto" truck may be useful in this operation.

CROSS REFERENCES

PLATE 2: Performance Data Gathering Form

Activity Code No. _____ Date _____

Method _____ Unit of Measure _____

District _____ Foreman No. _____ County _____

Highway No. _____ Location _____
(Milepost, distance from intersection, etc.)

PERSONNEL DATA

Title	Comp Rate	Hours in Preparation	Hours on Travel	Hours Traffic Control	Hours Performing Activity	
		Indicate number of hours spent in yard preparing equipment, materials, etc. requiring 30 or more minutes, less than 30 show under travel time.	Indicate the number of hours spent on travel from warehouse to work site.	Indicate the number of hours spent on traffic control (setting and removing signs and barricades, flagging, etc.) if 30 minutes or more.	Indicate the number of hours spent doing the method, include time spent on travel or traffic control less than 30 minutes.	

EQUIPMENT DATA

Equip. Number	Rate	Hours or Miles in Preparation	Hours or Miles on Travel	Hours, Miles Traffic Control	Hours, Miles Performing Activity	Description of Equipment
						Indicate type, name, size of equipment used.

Quantity of Material Charged _____

Unit Cost of Material Charged _____

Total Cost of Material Charged _____

Quantity of Work Performed _____ Work Performed per Day _____

Labor Required _____ (Hrs/Unit) Unit Cost _____

TABLE 1: HIGHWAY EXPENDITURES IN TEXAS

YEAR	TOTAL DISBURSEMENTS	CONSTRUCTION	MAINTENANCE
60-61	381,611,493.03	297,165,762.62	56,592,461.47
61-62	384,345,117.70	296,893,843.81	58,050,088.15[b]
62-63	410,897,834.26	318,357,686.22	61,384,472.09
63-64	466,357,175.67	304,934,508.65	65,649,378.21[b]
64-65	451,909,168.85	347,901,572.54	69,265,454.88
65-66	470,945,064.73	361,229,423.38	72,943,897.02[b]
66-67	562,358,008.43	466,242,984.09	64,461,436.83
67-68	547,505,442.17	407,545,010.17	76,493,802.81[a]
68-69	596,302,638.42	447,685,578.01	80,671,359.90
69-70	682,469,094.86	514,782,405.36	88,537,703.41[a]
70-71	708,897,968	525,843,854	95,075,336
71-72	669,939,862.44	474,422,698.41	103,613,168.84[a]
72-73	640,754,258	431,670,158	116,341,062

a) Regular Maintenance, Betterment, Traffic Services and Structural maintenance.

b) Special and regular maintenance betterments and traffic services.

(after reference 1)

TABLE 2: SUMMARY OF RESPONSES TO LETTER REQUESTS

STATE	RESPONDER
Arkansas	Bert Rownd Maintenance Engineer
California	C. E. Forbes Maintenance Engineer
Illinois	E. J. Keel Engineer of Maintenance
Louisiana	F. E. Crawford Assistant Road Maintenance Engineer
Minnesota	J. S. Katz Maintenance Methods Engineer
New Jersey	John C. Gibson Chief Engineer Construction and Maintenance
North Carolina	Paul J. DuPre State Maintenance Engineer
South Dakota	Eugene Rowen Project Coordinator Highway Maintenance Study
Utah	Henry C. Helland Director of Highways
Virginia	C. O. Leigh Assistant Maintenance Engineer
Washington	Donald R. Anderson Roadway Maintenance Engineer

TABLE 3: CLASSIFICATION OF MAINTENANCE OPERATIONS

Present THD Method (6)	Proposed THD (7)	AASHO (8)	THD (Proposed) District 2 (9)	NCHRP Report 42 (10)	Arizona (11)	California (12)	Florida (13)	Proposed Idaho (14)	Proposed Iowa (15)	Louisiana Study (16) (Jorgensen)	Louisiana (17)	Minnesota (18)	Mississippi (19)	Oklahoma (20)	Oregon (21)	Texas Study (Jorgensen) 5	Virginia Maint. Study (22) (Jorgensen)	Washington (23)
Base & Surface	Subgrade	Routine Roadway	General Section Expense	Routine Roadway Surface Operations	Routine Surface	General Maintenance	Bridges	Traffic Services	Overhead Operations	Bituminous Surface	Surface	Roadway Surfaces	Routine Roadway Surface Operations	General Highway Maintenance	Safety & Traffic Control	Hard Surface & Hard Shoulder	Surface	Roadway
Shoulders, Side Approaches, Roadside Drainage & Structures	Base	Special Roadway Surface	Regular Roadway	Special Roadway Surface Operations	Shoulders & Sides	Major Slides & Storm Drainage Repair	Tunnels	Traveled Roadway	Routine Surface	Concrete Surface	Shoulders, Approaches, Roadside, Drainage	Shoulders, Approaches, Sidewalks	Shoulders, Side Approaches, & Sidewalks	Emergency Actions	Drainage	Non-Hard Surface	Shoulders	Shoulders & Road Approaches
Guide Markings, Markers, Signs, Signals & Lighting	Surface	Shoulders & Side Approaches	Emergency Traffic Services	Shoulders	Roadside & Drainage	Restoration & Traffic Services	Ferries	Shoulders, Side Approaches & Sidewalks	Special Surface	Gravel or Shell Surface	Structures	Roadsides	Drainage & Beautification	Roadway Surfaces	Roadway	Gravel Shoulders	Drainage	Roadside
Parks & Plants	Concrete Pavement	Drainage	Traffic Operations Undistributable	Roadside & Drainage	Structures	Maintenance Performed by Cities	Surface & Base	Drainage System	Shoulder & Approach	Shoulder & Approach	Traffic Services	Drainage Facilities	Traffic Service	P.C.C. Surfaces	Shoulders	Vegetation Control	Roadside	Drainage
Row Maintenance (Except Mowing)	Shoulders	Roadside & Landscape	Traffic Directions	Structures	Snow, Ice & Sand Control	Roadside Pests	Roadsides	Bridges & Structures	Roadside & Drainage	Roadside & Drainage	Miscellaneous	Bridges & Tunnels	Snow, Ice & Sand Control	Bituminous Surfaces	Roadsides	Roadside	Traffic Services	Major Structures
Assistance to Traffic, Emergency Snow & Ice Removal	Bridges	Structures	Traffic Protection	Snow, Ice and Drift Sand	Traffic Services	Buildings & Grounds	Drainage	Roadside	Snow & Ice	Structural		Safety & Traffic Control Devices	Structures	Asphaltic Repairs	Snow & Ice	Drainage & Major Structures	Snow & Ice Control	Snow & Ice Control
Mowing Row	Culverts	Snow & Ice Control	Beautification & Comfort	Traffic Control & Service Facilities	Emergency Maintenance	Landscaping & Functional Planting	Signs	Buildings & Yards	Traffic Service	Traffic Service		Snow Removal, Ice Control, & Drift Prevention	Extraordinary Maintenance	Earth & Gravel Surfaces	Bridges	Traffic	Structures	Traffic Services
Rest Areas with Comfort Stations	Pipe	Traffic Control & Motorists Services	Special Maintenance	Other Services	General Functions		Centerline & Pavement Markings	Disaster Repairs	Other			Structures	General Expenses	Drainage	Highway Structures	Snow & Ice		
Channel & Embankment	Row Maintenance	Litter Pickup		Unusual or Disaster			Traffic Signals	Administrative & Miscellaneous Operations					Supervision	Shoulders & Approaches	Traffic Services	Extraordinary		
Substructure	Signs and Safety	River Crossings					Turnouts, Driveways & Crossovers							Major Structures	Roadside Recreational Areas	General		
Superstructure (Deck)	Pavement Markings	Other Services					Beautification							Minor & Miscellaneous Structures		Cattle & Stock-piling		
Superstructure (Supporting Members)	Erosion Control	Unusual or Disaster					Recreation Facilities							Roadside				
Railing	Emergence Services	General Supervision					Plaques & Historical Markers							Traffic Service				
Painting Except Railing	Rest Areas & Comfort Stations						Emergencies							Snow & Ice Control & Removal				
Special Jobs	Miscellaneous													Special Highway Work				

TABLE 4: ORIGINAL PANEL MEMBERS 1972

PANEL	NAME	MEMBERS
A	BASE AND SUBGRADE	J. M. McDowell, *Chairman, Dist. 1* L. S. Thompson, *Dist. 10* J. N. Dominey, *Dist. 11* J. O'Connell, *Dist. 17* R. P. Hudson, *Dist. 19*
B	BITUMINOUS SURFACES AND SHOULDERS AND APPROACHES	S. G. Cox, Jr., *Chairman, Dist. 21* J. L. Wilder, Jr., *Dist. 14* W. B. Collier, *Dist. 15* W. F. Adams, *Dist. 22* R. S. Martin, Jr., *Dist. 23*
C	PORTLAND CEMENT CONCRETE SURFACES	V. F. Matusek, *Chairman, Dist. 13* B. E. Davis, *Dist. 2* G. G. Cleveland, *Dist. 9* J. H. Doss, *Dist. 12* C. H. Brown, *Dist. 20*
D	ROADSIDE MAINTENANCE	A. L. McKee, *Chariman, Dist. 8* F. L. Ragland, *Dist. 3* R. C. Liles, *Dist. 4* J. W. King, *Dist. 5* J. H. Swaringen, *Dist. 25*
E	STRUCTURES	J. R. Evans, *Chairman, Dist. 7* R. S. Neal, *Dist. 6* H. Schneeman, Jr., *Dist. 16* G. Green, *Dist. 18* J. L. Lawrence, *Dist. 24*

TABLE 5: PRESENT PANEL MEMBERS 1974

PANEL	NAME	MEMBERS
A	BASE AND SUBGRADE	J. M. McDowell, *Chairman, Dist. 1* L. S. Thompson, *Dist. 10* J. N. Dominey, *Dist. 11* W. T. Byford, *Dist. 17* R. P. Hudson, *Dist. 19*
B	BITUMINOUS SURFACES AND SHOULDERS AND APPROACHES	S. G. Cox, Jr., *Chairman, Dist. 21* J. L. Wilder, Jr., *Dist. 14* W. B. Collier, *Dist. 15* W. F. Adams, *Dist. 22* R. S. Martin, Jr., *Dist. 23*
C	PORTLAND CEMENT CONCRETE SURFACES	V. F. Matusek, *Chairman, Dist. 13* B. E. Davis, *Dist. 2* G. G. Cleveland, *Dist. 9* J. H. Doss, *Dist. 12* C. H. Brown, *Dist. 20*
D	ROADSIDE MAINTENANCE	F. L. Ragland, *Chairman, Dist. 3* R. C. Liles, *Dist. 4* W. M. Pope, *Dist. 5* F. N. Shave, *Dist. 8* J. H. Swaringen, *Dist. 25*
E	STRUCTURES	J. R. Evans, *Chairman, Dist. 7* R. S. Neal, *Dist. 6* R. G. Welsch, *Dist. 16* G. Green, *Dist. 18* J. L. Lawrence, *Dist. 24*

APPENDICES

APPENDIX A. MAINTENANCE ACTIVITY COST CODES

100 Base and Subgrade

110 Removal of Base and/or Subgrade

120 In Place Repair - No Stabilizer

130 In Place Repair - Stabilizers (Maintainer)

131 In Place Repair Existing Base and/or Subgrade - Add Lime
132 In Place Repair Existing Base and/or Subgrade - Add Cement
133 In Place Repair Existing Base and/or Subgrade - Add Asphalt
134 In Place Repair Existing Base and/or Subgrade - Add Sand
135 In Place Repair Existing Asphalt Stabilized Base - Add Sand

140 In Place Repair - Stabilizers (Maintainer and Mixing Machine)

141 In Place Repair Existing Base and/or Subgrade - Add Lime
142 In Place Repair Existing Base and/or Subgrade - Add Cement
143 In Place Repair Existing Base and/or Subgrade - Add Asphalt
144 In Place Repair Existing Base and/or Subgrade - Add Sand
145 In Place Repair Existing Asphalt Stabilized Base - Add Sand

150 Repair Existing Base and/or Subgrade Other Than In Place

160 Install and/or Maintain Sub-drains - All Types

200 Surfaces

210 Seal Coat

211 Aggregate Seal Coat
212 Strip or Spot Seal Coat - Major
213 Strip or Spot Seal Coat - Minor
214 Fog or Sheet Sealing

220 Leveling or Overlay

221 Spot Leveling - Blade Spread
222 Spot Leveling - Hand
223 Spot Leveling - Hot Box
224 Level-up Blade - Sections
225 Level-up Blade - Continuous
226 Overlay - Major
227 Overlay - Minor
228 Underseal

230 Improve Texture

231 Treat Bleeding Pavement - Add Aggregate
232 Treat Bleeding Pavement - Heating Aggregate
233 Treat Bleeding Pavement - Heating Pavement
234 Heater Planer Work
235 Grooving (ACP)
236 Grooving (Concrete Pavement)
237 Improve Pavement Texture - Basic (CRCP)
238 Improve Pavement Texture - Basic (RCP)

240 Rutting and Shoving

241 Repair Rutting and Shoving - Basic
242 Repair Rutting and Shoving - Trim and Overlay

250 Cracks and Joints

251 Seal Cracks and/or Joints - Major
252 Seal Cracks and/or Joints - Minor
253 Seal Cracks - Squeegee
254 Seal Cracks - Major Operation (CRCP)
255 Seal Cracks - Minor Operation (CRCP)
256 Seal Cracks - Hot Rubber (CRCP)
257 Seal Cracks - Major Operation (RCP)
258 Seal Cracks - Minor Operation (RCP)
259 Seal Cracks - Hot Rubber (RCP)

260 Potholes and Spalling

- 261 Repair Potholes - Permanent
- 262 Repair Potholes - Temporary
- 263 Repair Potholes - Hot Box
- 264 Repair Spalling - Basic (Epoxy-CRCP)
- 265 Repair Spalling - Asphaltic Concrete (CRCP)
- 266 Repair Spalling - Basic (Epoxy-RCP)
- 267 Repair Spalling - Asphaltic Concrete (RCP)

270 Edge Repairs

- 271 Edge Repairs - Basic
- 272 Edge Repairs - Box
- 273 Seal Joint Between Pavement and Shoulder - Basic (Cat Blown-CRCP)
- 274 Seal Joint Between Pavement and Shoulder - Cutback (CRCP)
- 275 Seal Joint Between Pavement and Shoulder - Basic (Cat Blown-RCP)
- 276 Seal Joint Between Pavement and Shoulder - Cutback (RCP)

280 Remove and Replace Concrete Pavement

- 281 Removing and Replacing - Basic (CRCP)
- 282 Removing and Replacing - Fast Set Cement (CRCP)
- 283 Removing and Replacing - Stabilized Base (CRCP)
- 284 Removing and Replacing - Normal Portland Cement (Minor Repairs-CRCP)
- 285 Removing and Replacing - Basic (RCP)
- 286 Removing and Replacing - Fast Set Cement (RCP)
- 287 Removing and Replacing - Stabilized Base (RCP)
- 288 Removing and Replacing - Normal Portland Cement (Minor Repairs-RCP)

290 Blow-ups, Joint and Stress Relief

- 291 Repair Blow-up - Permanent (RCP)
- 292 Repair Blow-up - Temporary (RCP)
- 293 Seal Contraction and Expansion Joints - Basic (RCP)
- 294 Seal Contraction and Expansion Joints - Emulsion with Latex (RCP)
- 295 Seal Contraction and Expansion Joints - Hot Rubber (RCP)
- 296 Stress Relief - CRCP
- 297 Stress Relief - RCP

400 Shoulders and Approaches

410 Seal Coat Shoulders

411 Aggregate Seal Coat Shoulders
412 Strip or Spot Seal Coat Shoulders - Major
413 Strip or Spot Seal Coat Shoulders - Minor
414 Fog or Sheet Sealing Shoulders

420 Leveling or Overlay Shoulders

421 Spot Leveling Shoulders - Blade Spread
422 Spot Leveling Shoulders - Hand
423 Spot Leveling Shoulders - Hot Box
424 Level-up Shoulders - Blade, Sections
425 Level-up Shoulders - Blade, Continuous
426 Overlay Shoulders - Major
427 Overlay Shoulders - Minor

430 Treat Bleeding, Rutting and Shoving Shoulders

431 Treat Bleeding Shoulders - Add Aggregate
432 Treat Bleeding Shoulders - Heating Aggregate
433 Treat Bleeding Shoulders - Heating Paved Shoulder
434 Heater Planer Work Shoulders
435 Repair Rutting and Shoving Shoulders - Basic
436 Repair Rutting and Shoving Shoulders - Trim and Overlay

440 Cracks and Joints, Shoulders

441 Seal Cracks and/or Joints, Shoulders - Major
442 Seal Cracks and/or Joints, Shoulders - Minor
443 Seal Cracks, Shoulders - Squeegee

450 Potholes and Edge Repairs, Shoulders

451 Repair Potholes, Shoulders - Permanent
452 Repair Potholes, Shoulders - Temporary
453 Repair Potholes, Shoulders - Hot Box
454 Edge Repairs, Shoulder - Basic
455 Edge Repairs, Shoulder - Box

460 Repair Existing Base and/or Subgrade Other Than In Place, Shoulders

461 Removal of Base and/or Subgrade, Shoulders
462 Replacement of Removed Base and/or Subgrade, Shoulders - Stabilized Material
463 Replacement of Removed Base and/or Subgrade, Shoulders - Non-Stabilized Material

470 In Place Repair Existing Base and/or Subgrade, Shoulders

- 471 In Place Repair Shoulders - No Stabilizer
- 472 In Place Repair Shoulders - Add Lime (Maintainer)
- 473 In Place Repair Shoulders - Add Cement (Maintainer)
- 474 In Place Repair Shoulders - Add Asphalt
- 475 In Place Repair Shoulders - Add Sand (Maintainer)
- 476 In Place Repair Shoulders - Add Lime (Maintainer and Mixing Machine)
- 477 In Place Repair Shoulders - Add Cement (Maintainer and Mixing Machine)
- 478 In Place Repair Shoulders - Add Asphalt (Maintainer and Mixing Machine)
- 479 In Place Repair Shoulders - Add Sand (Maintainer and Mixing Machine)

480 Unpaved Shoulders

- 481 Recondition Sod Shoulders
- 482 Blade Flexible Shoulders - Maintainer and Pneumatic Roller
- 483 Blade Flexible Shoulders - Two Machines
- 484 Blade Flexible Shoulders - One Machine Kickoff Blade
- 485 Blade Flexible Shoulders - Maintainer

490 Approaches, Driveways, Turnouts

- 491 Public Side Road Approaches
- 492 Driveways - Valley and Pipe Type
- 493 Driveways - Safety Island

500 Roadside Maintenance

510 Mowing

511 State Owned Mowers
512 Leased Mowers
513 Full Width Mowing - State Owned Mowers
514 Full Width Mowing - Leased Mowers
515 Specialized Mowers
516 Hand Clean-up

520 Litter

521 Litter Pick-up - Hand
522 Litter Pick-up - Machine (Tow Type)
523 Litter Pick-up - Machine (Self-propelled with Shredder)
524 Street Sweeping
525 Maintain Litter Barrel

530 Rest Area Maintenance

531 Maintain Rest Areas - Comfort Stations
532 Maintain Rest Areas

540 Chemical Vegetation Control

541 Chemical Vegetation Control - Basic
542 Chemical Vegetation Control - Shoulder Edges
543 Chemical Vegetation Control - Spray Mesquite
544 Chemical Vegetation Control - Channels

550 Establish and Maintain Vegetation

551 Establish Vegetation - Basic
552 Establish Vegetation - Mulch Sodding
553 Establish Vegetation - Asphalt Mulch
554 Establish Vegetation - Small Hand Operation
555 Establish Vegetation - Disk or Drill
556 Maintain Sprinkler System Urban Areas

560 Pruning and Planting

561 Pruning and Brush Control - Minor
562 Pruning and Brush Control - Major
563 Pruning and Brush Control - Chipper
564 Planting - Large
565 Planting - Small

570 Silt and Erosion

571 Silt Removal - Basic
572 Silt Removal - Hydraulic Telescopic Boom Type Excavating Machine
573 Reshape Ditch and Slope - Basic
574 Ditch Retards - Grass
575 Ditch Retards - Concrete
576 Ditch Retards - Other
577 Ditch Liners - Jute
578 Ditch Liners - Concrete

580 Remove Silt From Culverts

581 Up to 36"
582 36" to 6' x 6'
583 6' x 6' to Bridge Class

600 Structures Over 20 Feet

601 Inspection Cost

610 Bridge Decks

611 Repair of Bridge Deck Spalling and Delamination - Portland Cement
612 Repair of Bridge Deck Spalling and Delamination - Epoxy
613 Repair of Bridge Deck Spalling and Delamination - Quick Setting Cements
614 Armor Joint Repair
615 Clean Bridge Deck - Mechanical
616 Clean Bridge Deck - Hand

620 Substructure - Concrete

621 Substructure Crack Repair
622 Substructure Crack Repair - Pressure Grouting
623 Repair of Badly Cracked or Spalled Substructure
624 Repair of Badly Cracked or Spalled Substructure - Collar
625 Repair of Badly Cracked or Spalled Substructure - Gunite
626 Repair Bearing Plates - Replace Lead Sheeting (Concrete Beams)
627 Substructure Waterproofing
628 Substructure Waterproofing - Epoxy Coating

630 Substructure Steel

631 Repair of Steel Substructure
632 Repair of Steel Substructure - Asphalt

640 Substructure - Timber

641 Repair of Timber Substructures
642 Removal of Timber Substructures

650 Railing

651 Paint Railing - Spray (Hand Cleaning)
652 Paint Railing - Hand
653 Paint Railing - Spray (Sandblast Cleaning)
654 Paint Railing - Touch-up
655 Metal Bridge Railing Repair
656 Concrete Bridge Railing Repair

660 Paint Bridges

661 Brush-off Blast
662 Near White
663 Touch-up

670 Channels and Riprap

671 Maintain Channels
672 Maintain Channels - Remove Drift
673 Repair and/or Replace Concrete Riprap
674 Remove Silt From Culverts

680 Linseed Oil

681 Linseed Oil Treatment of Bridge Decks

691 Biennial Safety Inspection
692 Damage Inspection

700 Traffic Services

710 Guide Markings

711 Center Stripe
712 Edgelining
713 Painting Traffic Medians and Islands
714 Zone and Pavement Markings
715 Install Traffic Buttons
716 Maintain Traffic Buttons

720 Delineation and Railing

721 Erect and Maintain Guard Fence and Railing
722 Maintain Concrete Median Barrier
723 Erect Delineators
724 Replace Damaged Delineators
725 Clean Delineators

730 Signs

731 Special Sign Studies
732 Install New Signs
733 Replace Signs
734 Repair Signs
735 Replace or Repair Traffic Damaged Signs
736 Replace or Repair Vandalized Signs
737 Wash Signs
738 Wash Vandalized Signs
739 Sign Clear Coating

740 Signals and Illumination

741 Install Signals
742 Install Illumination
743 Maintain Signals
744 Maintain Illumination
745 Replace or Repair Traffic Damaged or Vandalized Signals
746 Replace or Repair Traffic Damaged or Vandalized Illumination
747 Sign Illumination
748 Safety Lighting

750 Reimbursement to Railroad Companies (D-18 Use Only)

800 Extraordinary Maintenance

801 Emergency Repairs Due to Flooding

802 Emergency Repairs Due to Hurricanes

803 Emergency Repairs Due to Tornadoes

804 Emergency Repairs Due to Other Causes

810 Assistance to Traffic Other Than Caused by Snow and Ice

- 811 Assistance Needed Due to Floods or Flooding
- 812 Assistance Needed Due to Hurricanes
- 813 Assistance Needed Due to Tornadoes
- 814 Assistance Needed Due to Accident
- 815 Operation of Nail Picker
- 816 Removal of Sand Drifts

820 Assistance to Traffic - Snow and Ice

- 821 Assistance Needed Due to Snow and Ice
- 822 Plow Snow or Ice
- 823 Sand Bridges
- 824 Sand Roadway
- 825 Deicing Agents
- 826 Remove Sand, etc., - Mechanical
- 827 Remove Sand, etc., - Hand