

ANALYSIS OF MAINTENANCE COSTING WITH EMPHASIS
ON CONTRACTING VERSUS USING STATE FORCES

by

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT-----	v
ACKNOWLEDGEMENTS-----	vii
FINDINGS AND CONCLUSIONS-----	ix
IMPLICATIONS OF RESEARCH AND RECOMMENDATIONS-----	xiii
INTRODUCTION-----	1
PURPOSE AND SCOPE-----	2
EXPERIENCE OF VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION WITH CONTRACT MAINTENANCE-----	2
Definition of Terms-----	2
Expenditures in the Contract Maintenance Program-----	3
The Decision to Use Contract Maintenance-----	6
Advantages and Disadvantages of Contract Maintenance---	7
Advantages-----	7
Disadvantages-----	8
Future Use of Contract Maintenance-----	8
EXPERIENCE OF OTHER STATE AND LOCAL AGENCIES WITH CONTRACT MAINTENANCE-----	9
Maintenance Activity Contract-----	10
General Maintenance Contract-----	11
Advantages and Disadvantages of Contract Maintenance---	12
Advantages-----	12
Disadvantages-----	13
MAKE-VERSUS-BUY ANALYSIS AND THE MAINTENANCE COST QUESTION--	13
Costs-----	15
The Broad View Versus the Narrow View of Costs-----	15
Comparability of Estimates-----	16
Unit Costs-----	16
State Force Costs-----	17

TABLE OF CONTENTS continued

	<u>Page</u>
Identifying Variable and Fixed Costs-----	18
Guidelines for Using Variable and Fixed Costs----	19
Working Unit Capacity-----	21
Department's Cost Accounting-----	22
Fixed Costs-----	24
Variable Costs-----	26
Quality-----	26
Arguments for Using State Forces-----	27
Arguments for Using Contracts-----	28
Quantity-----	29
THE STATE FORCE-CONTRACT MAINTENANCE DECISION PROCESS-----	30
REFERENCES-----	33
APPENDIX A — LIST OF VIRGINIA'S MAINTENANCE ACTIVITIES-----	A-1
APPENDIX B — SPECIAL PROVISIONS FOR GENERAL MAINTENANCE CONTRACT — STATE OF IOWA-----	B-1
APPENDIX C — SPECIAL PROVISIONS FOR MAINTENANCE ACTIVITY CONTRACT — STATE OF ARIZONA-----	C-1

ABSTRACT

The authors present the findings of a study to develop a methodology for analyzing decisions of whether to perform ordinary maintenance, maintenance replacement, and incidental construction with state forces or to let them to contract. In developing the method, the authors interviewed resident engineers and examined the techniques most frequently used by the private sector in arriving at make-versus-buy decisions. In arriving at a decision to use contract maintenance, most resident engineers examine the magnitude of work, the time constraints faced, and whether the necessary state personnel and equipment are available. Routine cost analysis is not performed; thus contract maintenance has not been utilized to a significant degree as a manpower planning tool. The private sector, on the other hand, considers cost, quality of work, and quantity of work as major factors in make-versus-contract decisions. The methodology developed is depicted in flowchart form for easy application by decision makers in the budget preparation process.

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FINDINGS AND CONCLUSIONS

1. Virginia's average annual expenditure for highway contract maintenance is \$66.5 million, of which \$57.4 million are for maintenance replacement activities, \$6.9 million for incidental construction, and only \$2.1 million for ordinary maintenance.
2. Surface replacement activities classified as maintenance replacement account for the largest contract maintenance expenditure, with \$41.0 million, or 61.7% of the total contract maintenance program.
3. When compared to those of other states, Virginia's expenditures for contract maintenance may be overstated, since Virginia's maintenance program includes some activities that are classified as betterment, reconstruction, and construction activities by American Association of State Highway and Transportation Officials definitions.
4. In arriving at a decision to use contract maintenance, most resident engineers seek to answer the following questions:
 - a. What is the magnitude of the work to be performed?
 - b. How quickly must the work be accomplished?
 - c. Are state forces and equipment available to perform the work within the time required?
5. Most resident engineers view contract maintenance as a means of obtaining specialized equipment and additional manpower that are unavailable during peak work load periods and during emergencies.
6. Most resident engineers do not routinely perform a cost analysis when considering whether to use contract maintenance.
7. Increasing maintenance requirements on the aging interstate system, as well as reduced state employment levels, will present increasing opportunity to utilize contract maintenance as a manpower planning tool. The extent to which additional contract maintenance is successful as such a management tool rests with the ability and desire of the Department to be innovative in developing a competitive contract maintenance industry.
8. In order for a cost analysis to be beneficial in the contract maintenance question, the state force performance of the activity must be comparable to the contract performance in all respects, i.e., in quality, materials specifications, and time of completion.

9. Form A-21, the Residency Daily Cost Report, could be used to develop a cost summary of sufficient detail to provide the resident engineer with a historical perspective to the direct costs and quantities typically required for maintenance activities. These figures could be compared with bids a contractor might submit in much the same fashion as is done with the "historical bid estimates" developed by the Construction Division for use in awarding construction contracts.
10. In addition to costs, quality and quantity considerations are important factors relevant to state force versus contract maintenance decisions.
11. The calculation of state force costs for any maintenance activity requires that the resident engineer (or other appropriate administrator) estimate the direct variable costs associated with the activity as well as the variable overhead. Direct variable cost includes direct labor, inspection, materials, equipment, and any subcontract costs. Variable overhead includes material handling, delivery, and testing; drafting and engineering, if any; direct labor fringe benefits, social security, and workman's compensation; foremanship; shop labor for preparation of gauges etc.; power and fuel; travel to and from the job site; and set up and tear down time for the preparation or conversion of equipment.
12. An understatement of direct variable costs or variable overhead costs will tend to bias decisions toward the use of state forces if nonfinancial considerations are equivalent.
13. If some maintenance activities must be let to contract because the working unit (for example, the residency) cannot complete all activities, the total cost of performing maintenance will be minimized by performing with state forces those activities for which the contract bid price exceeds the estimated state force direct variable costs and variable overhead costs by the greatest margin, until the capacity of the state force work unit is reached.
14. If the capacity of the work unit is not a serious constraint, the total cost of performing maintenance will be minimized by letting to contract only those activities for which the bid price is less than state force variable costs.
15. The VDHT Activity Code Manual can be used to categorize cost codes into direct variable costs and variable overhead costs for purposes of estimating state force costs.

16. With the exception of any differences in the cost of inspection and control, arguments based on quality of work and expertise favor the use of outside vendors.
17. Manpower management considerations tend to significantly favor the use of contract maintenance.
18. In view of programs in other states, the Department may wish to experiment with the use of general maintenance contracts on selected stretches of highway.
19. The success in developing viable maintenance contracts appears to be directly related to the effort put forth by both parties.
20. Many roadway agencies utilize both general maintenance and maintenance activity types of contracts to supplement state forces; however, it appears that the types of tasks performed by contract are easily defined and the quantities of work can be estimated quite accurately.
21. The advantages of contract maintenance identified by some highway agencies include (a) contracting can take advantage of new processes and techniques without in-house capital costs, (b) work loads can be varied in response to needs rather than to manpower at hand, (c) work programs can be rapidly altered because equipment purchases are not involved, (d) the private sector provides effective management incentives; (e) the number of an agency's personnel problems are reduced, (f) the need for in-house training for specialized work can be minimized, (g) contractors tend to continue to improve once they obtain contracts in order to retain the work, and (h) contract maintenance requires the contracting agency to adopt good management practices.
22. The disadvantages of contract maintenance identified by some highway agencies include (a) contracts increase paperwork, (b) incomplete or faulty work may increase costs, (c) direct control of work is lost, (d) low prices may lead to inferior workmanship, (e) scheduling problems with contractors may arise, (f) contractors may not be sufficiently sensitive to agency and public objectives, (g) in-house backup capabilities may deteriorate, and (h) contractors may not be sufficiently responsive to changing or unique conditions.

IMPLICATIONS OF RESEARCH AND RECOMMENDATIONS

Ultimately, the decision to use state force or contract maintenance is the responsibility of the resident engineer. In arriving at this decision, he seeks to answer the three questions cited in item 4 above. These questions address the essential nonfinancial factors identified in the study that should be examined before a decision to use state forces or contract maintenance can be made. However, they do not address the financial aspects of the decision process.

The analysis methodology developed in this report and depicted in a flowchart in Figure 1 of the report is not intended to encourage or discourage the use of contracts to accomplish highway maintenance, but is intended to provide the resident engineer with an analytical tool for determining which of two or more alternatives is the most cost-effective. The authors believe that the methodology is more suited for use in the budget preparation process rather than for application in day-to-day decisions. It is recognized that use of the methodology may identify courses of action which are contrary to the way maintenance or incidental construction activities have been done in the past; nevertheless, the methodology is sound and has potential for increasing cost-effectiveness in the Virginia Department of Highways and Transportation's operations.

The authors, therefore, make the following recommendations.

1. The management of the Department should review the analysis methodology presented in this report for its potential use as a budget planning tool for the state highway maintenance program and incidental construction program.
2. The management of the Department should recommend that the methodology be used by all resident engineers in the preparation of their maintenance budgets.
3. The management of the Department should commission the development of seminars outlining the cost methodology developed in this study and present them to appropriate residency, district and central office management personnel. The purpose of this training would be to ensure uniform application of the methodology across the state.
4. The management of the Department should consider the initiation of experimental general maintenance and

maintenance activity contracts. This would enable the Department to gain experience in many potential contract areas where the profit motive of the private sector may allow reductions in maintenance costs over the long run.

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INTRODUCTION

Studies published in 1981 by the R. J. Hansen consulting firm and the Joint Legislative Audit and Review Commission have made it abundantly clear that the maintenance responsibilities of the Virginia Department of Highways and Transportation will require increasingly large revenues. For FY 82-83 the maintenance allocation is \$263.4 million and represents 27% of the Department's budget.

For the period from 1982 to 1988, ordinary maintenance is expected to account for 57% of the cost for maintenance on the interstate system and maintenance replacement will account for the remaining 43%. Ordinary maintenance on the interstate system is expected to be performed almost entirely by Department employees, while 60% of the maintenance replacement will be accomplished by contractors. On the primary system for the same time period, ordinary maintenance is expected to comprise 50% of the primary maintenance budget and will be carried out almost entirely by state forces. Expenditures for contract maintenance are expected to account for 59% of the maintenance replacement costs on the primary system.

Because maintenance expenditures will require a significantly increasing share of the Construction and Maintenance Fund, and because there is a trend toward reductions in the state work force, the question of the proportion and type of maintenance activities that should be let to contract as compared to those that should be done by state forces takes on special significance. To obtain the information needed to address this question, a method of analyzing the performance of maintenance activities under the two arrangements is essential. The research reported here was undertaken to develop such a method.

PURPOSE AND SCOPE

The primary purpose of the study was to identify the factors and describe the variables that should be examined in deciding upon whether and when maintenance and incidental construction activities should be done by state forces as opposed to having them performed by contract.

The scope of the study included not only the estimation of state force costs but also a determination of nonfinancial considerations important in state force versus contract decisions. In addition, interviews were conducted with several resident engineers and maintenance division personnel regarding the current methods employed to decide when contract maintenance is to be used.

The first major section of this report outlines the state of contract maintenance in Virginia and offers some conclusions relevant to the contract versus state force issue based upon an analysis of the distribution of expenditures for various maintenance activities. The second section presents a discussion of the experience of other state and local agencies with contract maintenance. The third section is analytical, and it draws from the experience of the private sector to develop a method that can be used by Virginia Department of Highways and Transportation managers to analyze state force versus contractor assistance for maintenance and incidental construction activities.

EXPERIENCE OF VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION WITH CONTRACT MAINTENANCE

The objective of this portion of the study was to gather information describing the operational characteristics of the contract maintenance program used by the Department. Information was obtained from discussions with resident engineers and maintenance division personnel, and from reports generated from the Department's fiscal accounting and maintenance management systems and other sources.

Definition of Terms

The maintenance expenditures discussed below should be viewed in light of the definitions for ordinary maintenance, maintenance replacement, and incidental construction used by Virginia since they differ from those adopted by the American Association of State Highway & Transportation Officials (AASHTO).⁽¹⁾

Virginia defines ordinary maintenance as the function of preserving each type of roadway, structure, and facility as near as possible to its condition as constructed. The state's ordinary maintenance activities include surface patching, shoulder maintenance, ditch cleaning, mowing, trash pickup, sign repair, snow removal, snow fence erection, pavement marking, weigh station operation, and many other similar items. They include some activities that would be classified as physical maintenance and some that would be classified as traffic services under AASHTO definitions.

Virginia defines maintenance replacement as the function of restoring each type of roadway, structure, and facility as near as possible to its condition as constructed. The required activities are typically major work items involving continuous portions of roadway of 1,000 feet (305 m) or more, or the renovation of portions of roadways or structures requiring extensive or unusual work. Included are resurfacing, replacement of drainage pipe, removal of major slides, replacement of large signs and signals, and similar items. Some of Virginia's maintenance replacement activities would be classified as physical maintenance, betterment, and construction and reconstruction by AASHTO.

The Department defines incidental construction as any operation which changes the type, width, length, location, or gradient of a road, facility, or structure, or the function of building into, or adding to such road, facility, or structure, features that were not included in the original construction. It includes acquisition of right-of-way, earthwork, surface and base work, drainage, grading the roadside, and similar activities. Some of these would be classified as betterment and construction and reconstruction activities under AASHTO definitions. A list of Virginia's ordinary maintenance, maintenance replacement, and incidental construction activities is contained in Appendix A.

Expenditures in the Contract Maintenance Program

To gain insight into the manner in which Virginia expended contract maintenance funds over a three-year period, the authors compiled expenditures on maintenance replacement, incidental construction and ordinary maintenance. A three-year average of expenditures was used to reduce the effect of yearly variations in the maintenance effort. The information is presented in Table 1.

As shown in Table 1, an average of the \$66.5 million was expended annually in the state contract maintenance program — \$57.4 million for maintenance replacement, \$6.9 million for incidental construction, and \$2.1 million for ordinary maintenance. Thus 86.4% of the contract maintenance expenditures was for maintenance replacement, 10.4% was for incidental construction, and only 3.2% was for ordinary maintenance. Clearly, contract maintenance has a major role in maintenance replacement and only a minor role in the ordinary maintenance function.

Table 1

Three-Year Average of Contract Maintenance Expenditures
(Fiscal Years 1979-1980-1981)

ACTIVITY	ACTIVITY EXPENDITURE	PERCENT OF ACT. EXPEND. FOR CONTRACT MAINT.	AMT. OF ACT. EXPEND. FOR CONTRACT MAINT.	PERCENT OF TOTAL FOR CONTRACT MAINT.
<u>Ordinary Maintenance Activities</u>				
General Expense	\$ 8,213,712	0.10	\$ 8,606	0.01
Bituminous Surface	16,197,657	1.73	280,743	0.42
Concrete Surface	280,754	0.31	868	0.00
Non-Hard Surface	6,461,318	0.94	60,701	0.09
Shoulder Maintenance	3,928,753	1.02	40,095	0.06
Ditches & Drainage	11,386,259	1.60	182,677	0.27
Roadside	7,855,581	1.61	126,154	0.19
Vegetation Control	9,156,786	0.60	55,014	0.08
Signs & Traffic Control	4,779,863	1.63	78,104	0.12
Traffic Services & Operations	2,026,943	15.00	304,000	0.46
Snow & Ice Control	19,935,500	4.76	949,481	1.43
Structures	1,209,198	0.49	5,911	0.01
Drawbridges & Ferries	2,710,864	1.78	48,160	0.08
Weigh Stations	1,194,283	0.02	219	0.00
Tunnels	2,278,183	0.38	8,768	0.01
Bus Shelters	1,886	0.00	0	0.00
Supervision	7,502,098	0.00	23	0.00
SUBTOTAL	\$105,119,586	2.04	\$2,149,524	3.23
<u>Maintenance Replacement Activities</u>				
General Expense	\$ 3,689,434	58.04	\$ 2,141,292	3.22
Surface Replacement	49,739,307	82.49	41,027,650	61.71
Shoulders, Turnouts & Drainage	3,130,736	10.91	341,507	0.51
Roadside	3,929,220	29.27	1,150,044	1.73
Signs	5,160,338	1.28	65,941	0.10
Tunnels	6,023	100.00	6,023	0.01
Structures	5,901,951	40.85	2,411,217	3.63
Weigh Stations	27,387	1.37	374	0.00
Flood Damage	23,033,057	44.61	10,275,455	15.45
Supervision	154,647	0.00	0	0.00
SUBTOTAL	\$ 94,772,100	60.59	\$57,419,503	86.36

Table 1 Continued

ACTIVITY	ACTIVITY EXPENDITURE	PERCENT OF ACT. EXPEND. FOR CONTRACT MAINT.	AMT. OF ACT. EXPEND. FOR CONTRACT MAINT.	PERCENT OF TOTAL FOR CONTRACT
<u>Incidental Construction Activities</u>				
General Expense	\$ 464,850	30.44	\$ 141,484	0.21
Right-of-Way	668,499	0.49	3,301	0.01
Roadway Construction	5,174,884	17.58	909,867	1.37
Surface & Base	12,827,084	40.84	5,238,894	7.88
Shoulders & Entrances	414,877	16.74	69,458	0.11
Drainage Structures	1,130,052	3.66	41,307	0.06
Drainage & Small Drainage Structures	2,064,601	7.35	151,801	0.23
Traffic & Pedestrian Services	2,236,071	16.07	359,257	0.54
Roadside Development	602,726	0.25	1,523	0.00
Toll Free Ferries and Docks	129,519	0.00	0	0.00
Supervision	236,427	0.00	0	0.00
SUBTOTAL	\$ 25,949,590	26.66	\$ 6,916,892	10.41
CONTRACT MAINTENANCE PROGRAM TOTAL	<u>\$225,841,276</u>	<u>29.44</u>	<u>\$66,485,919</u>	<u>100.00</u>

Surface replacement, a maintenance replacement activity, accounted for the largest contract maintenance expenditure with \$41.0 million, or 61.7% of the total contract maintenance. This was followed by emergency flood damage with \$10.3 million, or 15.5% of the total, and surface and base work, an incidental construction activity, with \$5.2 million, or 7.9% of the total. Snow and ice control accounted for the largest contract maintenance expenditure of the ordinary maintenance activities with \$0.9 million, or 1.4% of the total contract maintenance program. The expenditure on snow and ice control was primarily for hired equipment and operators and represents 44.0% of the contract maintenance expenditure for ordinary maintenance.

For the purposes of this study, the Department's dependence on contract maintenance was determined by the percentage of the expenditure on an activity that went for contract maintenance. Contract maintenance accounted for 29.4% of the total expenditure on the highway maintenance program, or 60.6% of the maintenance replacement expenditure, 26.7% of the incidental construction expenditure, and 2.0% of the ordinary maintenance expenditure. For maintenance replacement activities, 82.5% of the surface replacement expenditure was for contract maintenance. This was followed by general expense at 58.0% and flood damage at 44.6%. For the incidental construction activities, 40.8% of the expenditure for surface and base work was for contract maintenance and for ordinary maintenance activities, 15.0% of the money spent on traffic services and operations was for contract maintenance.

In summary, Virginia expends an average of \$66.5 million annually on contract maintenance in its highway maintenance program. Of this amount, 86.4% is expended for maintenance replacement activities, 10.4% for incidental construction activities, and 3.2% for ordinary maintenance. The largest contract maintenance expenditure, \$41.0 million, was for surface replacement, which includes plant mix, slurry seals, surface treatments, and the like. Virginia's dependence on contract maintenance is greatest in maintenance replacement, where 60.6% of the expenditures is for contract maintenance. This is followed by incidental construction at 26.7% and ordinary maintenance at 2.0%. This information indicates that contract maintenance is a significant part of Virginia's highway maintenance program with primary emphasis in surface replacement activities.

The Decision to Use Contract Maintenance

The decision to use contract maintenance in emergency situations and for all maintenance work costing \$200,000 or less is the responsibility of the resident engineer. For expenditure items in excess of \$200,000 the Code of Virginia, §33.1-190, prohibits the use of state forces except in cases of emergency. While the decision ultimately rests with the resident engineer, concurrence with the decision of district and central office staff is common. Interviews with resident engineers revealed that in arriving at a decision to use contract maintenance they usually do not perform a cost analysis but seek to answer the following questions:

1. What is the magnitude of the work to be performed?
2. How quickly must the work be accomplished?
3. Are state forces and equipment available to perform the work within the time required?

If either proper and sufficient equipment and personnel are not available to perform the work in the time required, the decision is to use contract maintenance. Contract maintenance is viewed by most resident engineers as a means of obtaining specialized equipment and additional manpower that are unavailable during periods of peak work load and emergencies. The net result is that certain maintenance activities have consistently been performed by contract and others by state forces.

A number of maintenance activities have been accomplished by contract in Virginia. In ordinary maintenance, where an average of only \$2.1 million is expended annually on contract maintenance, the money has gone for snow removal, transporting materials, shoulder machining, ditching, bituminous patching, guardrail repair, and brush cutting. In maintenance replacement, where the annual expenditures in contracts averages \$57.4 million, the outlay is for surface treatments, bituminous overlays, slurry seals, pavement restoration, repair of slides and washouts, pipe replacement, major cleaning of outfall ditches, bridge work, concrete repair, and centerline marking. In incidental construction an average of \$6.9 million is expended annually on clearing and grubbing, grading, placing base material, repair and/or replacement of substructures and superstructures on bridges, riprap and incidental concrete, erecting guardrail, excavation, paving and surface treatment, installation of large pipe, and soil-cement stabilization.

Advantages and Disadvantages of Contract Maintenance

The ease or difficulties in using contract maintenance as perceived by a resident engineer can significantly affect his decisions. The following are lists of some of the advantages and disadvantages of utilizing contract maintenance noted in discussions with a few resident engineers. The lists in no way represent a consensus of the 45 state resident engineers.

Advantages

1. State force manpower and equipment can be supplemented during peak work load and emergency periods.
2. Specialized equipment can be made available to the Department without capital investment.
3. Specialized or extensive work activities can be performed in an expeditious manner.
4. State personnel and equipment can be released to perform other needed maintenance activities.

Disadvantages

1. The records required to monitor a maintenance contract can be voluminous and time consuming.
2. The availability of a contractor's hired equipment and manpower can vary depending upon his work schedule.
3. There can be a time lag in getting a contract under way.
4. There can be an unreasonably high cost in performing some activities by contract.
5. The inspection and supervision requirements may not be included in the state force manpower allocation, and the seasonal demand for these functions may be increased.

Future Use of Contract Maintenance

The contract maintenance program in Virginia represents a significant part (29.4%) of the total highway maintenance program. Its importance will probably increase as traffic volumes and vehicle weights increase and the roadway system ages. The increased need for maintenance will be more pronounced on the interstate system which, because of its relative newness, has been comparatively maintenance-free. Additionally, as this system ages, there will be an increase in the number of specialized and extensive work operations needed because of the high design standards for interstate roads. These factors, along with the pressure to reduce the number of state personnel, will increase the significance of the contract maintenance program in Virginia.

The success of the Department's contract maintenance program will depend upon its ability to develop a competitive contract maintenance industry. Therefore, the Department should initiate a program, as other states have done, to inform potential contractors, both large and small, of the contract maintenance program; it should encourage contractor participation by making multi-year commitments in new maintenance contract areas to allow contractors time to gear up and to arrange for the recovery of any necessary capital investments; and it should pursue innovative contract methods that could make working with the Department more appealing to contractors.

The contract maintenance industry is an integral part of Virginia's highway maintenance program, and all indications are that it will increase in size and significance. It provides an invaluable service during emergency situations; it plays a vital role in supplementing state forces during peak load periods; and it provides specialized equipment that the Department cannot afford to own. The Department's future success in using contract maintenance will depend upon its ability to develop competition among contractors.

EXPERIENCE OF OTHER STATE AND LOCAL AGENCIES WITH CONTRACT MAINTENANCE

The objective of this portion of the report is to describe some of the experiences of other state and local agencies with contract maintenance, not only to place the Virginia experience in perspective but possibly to learn from the recent efforts of several states in the ordinary maintenance area. The information presented was obtained from conversations and correspondence with maintenance engineers in Iowa, Arizona, Florida, South Carolina, New Mexico, and Texas, and published reports on contract maintenance experiences in Lafayette, California, and Scottsdale, Arizona.

The pressures to reduce the manpower levels in state and local roadway agencies have forced administrators to seek alternative ways of accomplishing necessary maintenance work to preserve their investments in the roadway systems. This section describes some of the current efforts in state and local agencies to accomplish this objective through supplementing agency forces with maintenance contracts. In the past, most roadway agencies have utilized maintenance contracts to accomplish maintenance activities beyond the capabilities of their own forces, either because of the magnitude of the effort or the specialized nature of the work. Now the lack of sufficient agency forces has forced many administrators to seek contractor assistance for many roadway maintenance activities which have traditionally been accomplished by agency forces. The private sector's response to this shift has been one of caution because of the lack of expertise in the maintenance area, the capital investment required for some activities, and the uneasiness associated with not knowing if these practices will be employed over a short term or a long term.

A number of approaches have been taken by roadway agencies in the development and administration of contract maintenance programs, with most of the differences among them being attributable to differences in laws which govern the use of public funds in contracts. However, there appear to be two major types of maintenance

contracts. The first is the maintenance activities contract. This type involves a limited number of tasks which a contractor is required to perform within a short period of time. Included in this type are seal coating, resurfacing, bridge painting, patching, mowing and similar activities. The other type is the general maintenance contract, which involves the accomplishment of numerous maintenance tasks on a designated section of roadway for a year or longer. It requires a contractor to perform most if not all of the maintenance activities. An example of some of the special provisions used in each of these maintenance contract types is contained in Appendixes B and C for Iowa and Arizona, respectively.

To date the maintenance activity contract has been used successfully by most roadway agencies, both state and local, and the general maintenance contract has been used by some local agencies^(2,3) and experimentally by some state agencies⁽⁴⁾ in the last few years. The major problems with the use of general maintenance contracts by state agencies appears to be the reduced control of the maintenance effort, the fear of inadequate response time to citizen complaints and emergency situations, and the logistical problems in administering the contract over a large geographical area.

Maintenance Activity Contract

The success of the maintenance activity contract lies in its similarities with the traditional construction contract. The tasks to be accomplished can be well defined and the quantities of work can be estimated quite accurately. Some of the maintenance tasks suited for maintenance activity contracts are as follows:

1. Resurfacing
2. Structure cleaning and painting
3. Structure repair
4. Painting surface markings
5. Roadside mowing
6. Landscaping
7. Shoulder repair
8. Guardrail repair and replacement
9. Weed spraying
10. Catch basin cleaning
11. Litter removal
12. Slide removal
13. Street sweeping
14. Roadway lighting
15. Sign maintenance

The effectiveness of contracting these activities appears to vary from agency to agency. One agency may report that contracting for a particular activity has been beneficial and identify cost savings and improved service to the public. Another agency, however, may report that its efforts to contract the same activity have resulted in additional costs to the motoring public and reduced service levels. Obviously, differences exist, but are the differences in the contractors performing the work or the requirements of the contracting agency? It appears that both the contractors and the contracting agencies contribute to these differences. In the states and localities with effective contract maintenance programs, the contracting agencies have put forth a great deal of effort to create an environment conducive to the development of a contracting industry for contract maintenance work. They have simplified the contract language. They have sized the contracts to match potential bidders' capabilities. In some instances, they have kept the contract amount under the limit which requires bonding. They have also scheduled the pre-bidders conferences at times convenient for contractors. On the other side, contractors have worked to familiarize themselves with what is required of them in maintenance contracts. They have submitted realistic bids and they have worked with the contracting agency to improve the work techniques and the efficiency of the maintenance operations. Thus, the success of an agency in developing a viable contract maintenance program appears to be directly related to the effort put forth by the contracting agency and the contracting industry.

General Maintenance Contract

General maintenance contracts require contractors to perform most if not all of the maintenance activities on a designated section of highway over an extended period of time. This differs from the maintenance activity contract in that numerous activities are involved instead of one or more, and the responsibility to perform these activities is for a relatively long period of time such as a year.

The development of a general maintenance contract is typically based on policy decisions on the levels of service to be provided and budgetary limitations. With the level of service identified, work programs are developed which estimate the kind and amounts of maintenance to be performed. This information is then placed on a work calendar which shows the number of days of work planned on a monthly basis for each major activity. The work calendar is a key element in the general maintenance contract program, because it is helpful to agency officials in budgetary planning and is helpful to the contractor in scheduling other work around his commitments to the government agency.

172

Three typical contracts are used in the general maintenance contract program. One is a unit price contract for maintenance activities with easily measurable work units. A majority of the maintenance activities are covered by this type. The second is a service contract for those activities which require a uniform amount of work on a regular basis. Custodial services at a rest area would be included in a service contract. The third is a cost plus contract for unpredictable or emergency work.

Advantages and Disadvantages of Contract Maintenance

Some agencies who use contract maintenance to supplement their forces have identified a number of advantages and disadvantages to its use. The following lists were developed from information gathered from a limited number of roadway agencies and are by no means inclusive of all factors.

Advantages

1. Contracting can take advantage of new processes and techniques without in-house capital outlays.
2. Work loads can be varied in response to needs rather than to manpower at hand.
3. Work programs can be rapidly altered because equipment purchases are not involved.
4. The private sector provides effective management incentives.
5. The number of an agency's personnel problems is reduced.
6. The need for in-house training for specialized work can be minimized.
7. Contractors tend to continue to improve once they obtain contracts in order to retain the work.
8. Contract maintenance requires the contracting agency to adopt good management practices.

Disadvantages

1. Contracts increase paperwork.
2. Incomplete or faulty work may increase costs.
3. Direct control of work is lost.
4. Low prices may lead to inferior workmanship.
5. Scheduling problems with contractors may arise.
6. Contractors may not be sufficiently sensitive to agency and public objectives.
7. In-house backup capabilities may deteriorate.
8. Contractors may not be sufficiently responsive to changing or unique conditions.

In summary, many roadway agency administrators are utilizing contract maintenance to supplement their forces. Two basic types of maintenance contracts are used by roadway agencies: the general maintenance contract and the maintenance activity contract. Regardless of the type of contract used, it appears that a roadway agency's success in using contract maintenance is directly related to the effort put forth by the contracting agency and the contracting industry.

MAKE-VERSUS-BUY ANALYSIS AND THE MAINTENANCE COST QUESTION

In the previous sections the experience of state and local roadway agencies with contract maintenance was described. Recently, the question of using contractors versus using state forces to perform highway maintenance has received increasing attention. Two states, namely Arizona and Iowa, have received mandates from their legislatures to examine contracting as an alternative to performing maintenance with state forces. Such interest stems largely from the severe budget constraint most highway agencies are facing. The budget constraint is really twofold. First, revenues are either declining in the nominal sense or are not increasing rapidly enough to offset inflation, and second, as highway systems get older, maintenance expenditures become an increasing share of the budget. With such pressures, highway administrators and legislators are looking for ways to either cut costs or operate more efficiently. One avenue being pursued is the potential for contracting certain maintenance functions.

Whether to use a contractor to perform an ordinary maintenance operation or to use state forces is a subject that is not addressed in the standard engineering and highway literature. Nevertheless, in attempting to outline and develop a formal decision-making process applicable in this context, literature on the more general procurement question of make-versus-buy can be applied. Simply stated, the make-versus-buy question deals primarily with the economic justification for making or buying a component by a business, and it is the intention that the analysis will lead to a decision which will substantially contribute to increases in sales and profits. While most often the analysis deals with whether to purchase or make materials or components that are to be processed into a final product, it is equally applicable to finished products and services.

Some managerial texts argue that the fundamental question facing a firm attempting to deal with make-versus-buy is whether or not it has the equipment and capacity to make the item.⁽⁵⁾ While in a sense the argument is correct, it is an oversimplification to the extent that even if equipment is unavailable it can be rented or purchased and labor can work overtime. Furthermore, a resident engineer's view of capacity is directly related to the prioritization of maintenance functions.* There are, nevertheless, lessons to be learned from make-versus-buy analysis as developed in the private sector, but adjustments must be made to structure the analysis to the maintenance activities of the Virginia Department of Highways and Transportation. The following discussion examines the factors most important in make-versus-buy decision making and applies them in the highway maintenance context.

Using state forces or contractors for the performance of maintenance or incidental construction activities is essentially a problem in the selection of a source. In many respects, this problem is similar to the ones faced daily by purchasing agents in trying to choose vendors, and, in fact, the objectives in each case — selection from outside vendors and selection between outside vendors and the organization itself — should be the same.⁽⁶⁾ These objectives serve as the basis for outlining the major factors which should enter the decision process for the Department and are as follows: (a) to supply the desired quality of service, (b) to supply service at the right time and place, and (c) to supply it in the proper quantity at as little cost as possible. (Note the similarity of objectives to those major contract maintenance

*For example, if all maintenance activities are considered as highest priority, then by working overtime it may still be impossible to complete the tasks; but if fewer activities are classified highest priority the capacity constraints are less important.

questions noted above by resident engineers.) Once stated, these objectives might have a tendency to inspire a reaction of "that's obvious" from many managers. Furthermore, organizations and businesses that have been operating for a significant number of years are often reluctant to entertain the in-house versus contract discussion, largely because of a predisposition to do things as they've been done in the past. Nevertheless, this report will use the previously noted objectives as a basis for the discussion of the factors most important in state force maintenance versus contracting maintenance decisions: cost, quality, and quantity. The results of the examination can then be used to encourage consistency of approach among resident engineers in deciding which activities will be done under contract and which will be done by state forces.

Costs

The Broad View Versus the Narrow View of Costs

The relative importance of cost in contracting or in-house decisions depends largely on one's perspective. In the broadest sense, most decisions in business can be said to be directed by the "least cost alternative." Similarly, one may reasonably argue that in providing highway maintenance the Department should choose that method which minimizes its cost in the long run. Consequently, in considering state force versus contracting as a maintenance technique this line of reasoning would argue that nonfinancial factors such as quality and quantity would be reduced to cost considerations in the broad sense as they relate to the long run budgetary position and goals of the Department. Choosing such a broad view of cost, is, however, practically useless for typical decisions faced by resident engineers because it offers little help in solving specific problems and contains so many incommensurable factors that developing a dollar estimate is impossible. Thus, the development of cost estimates necessitates restricting cost to a rather narrow definition, and in this stricter context cost becomes only a starting point in the state force versus contract decision process.

The narrow view of cost provides a basis from which to obtain an answer to a simpler set of questions than does the broad view of cost. In particular, the questions are, what is the financial cost to accomplish a particular maintenance activity by contract and what is it to accomplish the same activity by state forces. While this view of cost should be only part of any state force versus contract analysis it is of major importance. The sections which follow deal with this narrow view of cost and the conditions which must hold for estimates of each cost to be useful.

Comparability of Estimates

In state force versus contract decisions, it is extremely important that any difference between the estimated cost of state force work and that of contracting for the service must result from the choice of which method is used to supply the service. Unless this condition is met, the decision maker has little idea about the impact contracting or performing by state forces has on cost. Consider an example in a recent AASHTO survey in which a state highway department compared the costs of striping by contract and by state forces: Cost estimates per linear foot of striping in 1981 were \$0.02 for state forces and \$0.21 per linear foot under contract. However, the bidder specified the use of thermoplastic paint while the striping by state forces included the application of regular paint only. In this example, the cost comparison provides no basis for a decision on whether to use the contractor or state forces because "other things" (the type of marking) influenced the estimates. Comparability would have required a re-estimation of the costs of contracting and state force application with the same striping material.

Thus, it is clear that for cost analysis to be beneficial, cost estimates must be comparable in the sense that things other than the action of contracting or performing work by state forces must be the same. As a practical matter, this is rarely the case; therefore the decision maker must be acutely aware of those things which differ and make allowances in interpreting the cost figures. This consideration is particularly important in certain maintenance functions and the method by which they are performed. The municipality of Lafayette, California, for example, contracted its ditching operation. The contractor chose to fulfill the contract and provide drainage through an initial ditch cleaning and a subsequent program of vegetation management, the cost of which has proven to be less expensive than that of the conventional ditching operation performed in-house; but for the comparison to have meaning, the city engineer must decide whether the method used by the contractor is acceptable. If he decides in the affirmative, then the costs of ditching by in-house forces and the vegetation management techniques employed by the contractor really are comparable for decision-making purposes, even though the contractor isn't engaged in ditching in the traditional sense.

Unit Costs

In the private sector, buyers urge analysts to avoid the use of unit costs for analysis purposes, because a change in the volume of the item in question will change not only total costs but in many cases may influence unit costs as well. Nevertheless, the costs of the Department's maintenance activities are quoted in

unit prices; for example, in the case of stabilization the cost of stone is quoted as per ton in place.

As part of the current study, the authors have interviewed resident engineers, maintenance division staff, the Department's fiscal officer, and the state construction engineer. In addition, monthly cost reports (Form A-17), daily records for maintenance employees (Form DP-225), the residency daily cost report (Form A-21), and numerous bid proposals and awarded contracts have been reviewed. These interviews and reviews led to several conclusions relevant to the unit price question. First, the unit price emphasis is strong and appears to be a logical necessity of the bid process for construction and maintenance contracts. Second, the fact that bids are quoted in unit prices for contract purposes does not prohibit costs from being converted to totals for analysis purposes. Third, since cost information for maintenance and incidental construction activities originate at the residency and area headquarters levels and are not in unit price form, the resident engineer is the appropriate individual to estimate state force costs. Nevertheless, none of Forms A-17, DP-225, or A-21 are designed to provide the resident engineer with an easily accessible historical project or maintenance activity cost accounting, which is comparable to a bid proposal. Form A-21, the residency daily cost report, could, however, be used as an aid in developing a project or maintenance activity cost summary of sufficient detail to provide a consistent historical perspective of the costs and quantities typically required. Such a record is needed for the analysis described in the flowchart given later as Figure 1. These estimates can be compared with actual bids, or with estimated bids a contractor might submit, much in the same fashion as is currently done with the "historical bid estimates" developed by the construction division for use in awarding construction contracts.

State Force Costs

As noted above, cost is only the beginning of the state force versus contract decision process, but there are many problems associated with estimating costs. For example, the cost to perform an activity with state forces currently performed by contract is at best an estimate. It will vary depending upon the type of cost data available, how administrative and other types of overhead are treated, the level of activity of the working unit in question, and whether or not the equipment and expertise necessary to perform the activity are readily available. It was also noted that accurate analysis requires comparability of quality, specifications, quantity, etc. Even if this comparability test is met, the state force costs would still remain only an estimate. Thus, it is reasonable to argue that if a cost analysis estimates that there would be only a slight

780

cost reduction to perform by state forces a currently contracted activity, the contractor should probably be retained because of the uncertainty of the estimation process.

Gambino indicates that there is a great deal of debate over which costs are appropriate to consider in a make-versus-buy decision.⁽⁷⁾ Largely, the disagreement relates to whether to consider only variable costs or total costs including both fixed and variable costs. For the present discussion, the authors will first outline a typical distribution of fixed cost and variable cost categories. Secondly, general guidelines based upon business practice will be provided to indicate when to use variable and when to use total costs in an analysis. Thirdly, the Department's maintenance cost categories will be placed in the fixed and variable cost categories.

Identifying Variable and Fixed Costs

Variable costs are those costs which vary in direct proportion with output or the quantity of service, whether the activity is done by state forces or by contract. They can be broken down into direct variable costs and direct variable overhead. Direct variable costs are those items which are a part of the state force activity. For an ordinary maintenance activity like skin patching, pothole patching, crack sealing, etc., direct labor costs of performing and inspecting the work, direct material costs, direct equipment costs, and, in the case of tight capacity (like snow removal), any subcontract costs would be classified as direct variable costs.

Direct variable overhead costs are more numerous and difficult to define. Normally, however, they would include material handling, delivery, and testing costs; drafting and engineering labor (if any) associated with the activity; direct labor fringe benefits, social security taxes and compensation insurance; foremanship associated with the activity; indirect shop labor (for example preparation of gauges, instruments, special tools, or equipment maintenance); power (such as fuel) associated with the activity; travel costs to and from the work site; departmental supplies associated with the activity; any training costs of a special or nonroutine nature associated with the activity; and set up and tear down time for the preparation or modification of equipment.

Fixed costs are those costs which are unavoidable regardless of the action chosen. For example, if a firm prepays six months of insurance premium of which no portion is refundable or prorated, then insurance costs are fixed, even if the firm decides to shut down during the six months following payment of the premium. Under certain circumstances, some of the cost categories noted above under variable costs may, in fact, be considered as fixed and,

therefore, there is some merit in avoiding an inflexible categorization of fixed and variable costs. The following may illuminate this point. Currently a residency pays nothing for a piece of equipment unless that equipment is placed in use. Upon usage, however, a charge is placed against the activity budget on which it was used. The charge is a calculation based upon the hours the equipment was in service and its rental rate. This means that all equipment costs under the Department's accounting system are variable.* If, however, the Department decided to charge a lump sum minimum rental regardless of usage along with an hourly charge to provide an incentive to the residency to more efficiently use its equipment, then the minimum rental would be equivalent to an obsolescence charge and would be classified as fixed overhead, whereas the hourly charge would be a direct variable cost. There may be some uncertainty from time to time about the classification of costs between fixed and variable; nevertheless a manager (in this case the resident engineer) must take care not to overestimate fixed costs because it tends to bias decisions in favor of state force activity when, in fact, contractor bid prices may be very close to state force variable costs.

These special case considerations notwithstanding, those items usually termed as fixed overhead are the following:

1. general administration
2. general insurance
3. building repairs and maintenance
4. payroll, accounting, and associated labor.⁽⁸⁾

Guidelines for Using Variable and Fixed Costs

In the most recent text dealing with make-versus-buy decisions, published by the National Association of Accountants, the appropriate use of variable as opposed to total cost (variable plus fixed cost) is said to depend on two major factors: (1) capacity and level of operation, and (2) whether the analysis is being made for the short run or the long run.⁽⁹⁾

*It should be pointed out that unless equipment rental rates are based upon replacement costs rather than purchase price, such variable costs may be significantly understated.

An example may be helpful in outlining the influence of capacity on variable and total cost (variable plus fixed cost). Assume that a residency has been contracting all guardrail repair and replacement within its jurisdiction, but that a policy proposal has been made that all residencies shall make such repairs and replacement with state forces. The resident engineer reveals to top management that the residency has all of its people working on high priority activities and does not have the manpower and equipment necessary to accomplish this activity, and that the program budget for maintenance indicates the same will be true for the foreseeable future. In this case, if the policy proposal were carried out, there would be an increase in variable costs that are associated with guardrail repair (hiring additional employees) as well as additions to fixed overhead caused by having to purchase equipment and supervise guardrail repair with state forces.

On the other hand, if the residency will have some of its people working on low priority activities for the foreseeable future and it has the appropriate equipment, bringing guardrail repair and replacement in-house would involve only existing personnel and equipment. Thus the only increase in costs would be the change in variable costs associated with the guardrail work. For these conditions, any fixed costs which might be assignable to the operation are unavoidable and, due to the shifting of existing personnel, won't be altered regardless of whether guardrail repair continues as a contract item or becomes a residency operation. Thus, in this example fixed costs are not relevant to the decision of contracting versus state force maintenance of guardrail and a total cost (variable cost plus fixed cost) analysis is not appropriate.

In addition to capacity of the working unit as an influence on when to include both variable and fixed overhead costs to estimate the cost of state force activity, the time period under consideration is quite important. In a very real sense, all costs become variable if the period under consideration is the very long term. In shorter time frames, however, some costs are fixed. For this reason, the National Association of Accountants' Management Accounting Practices Committee, in its policy statement, "Criteria For Make or Buy Decisions," argues that

in the case of short-term (or temporary) decisions variable costs become more significant; however, it is recommended that the long-term and full-cost [total cost] considerations also be developed. The short-term judgements can then be properly evaluated against the alternative choices which will be required at a later date. (10)

Current business practices in the United States indicate that, in general, variable costs are used and considered sufficient in the determination of whether to contract for or make an item on a temporary basis, particularly if excess capacity exists. In making a decision for the long term, particularly if the operational policy of the firm is to be affected, total costs are generally used. Such rules are reasonable for the Department to follow as well.

Working Unit Capacity

Essentially two sets of circumstances arise where contract versus state force questions are relevant to maintenance and the incidental construction activities of the Department. The first is when manpower and/or equipment capacity is not large enough to provide the service required, even given the use of overtime. The second is when capacity exists at a level sufficient to provide all services with state forces. For the first set of circumstances, the problem is to decide which functions to perform with state forces and which to perform by contract. For the second set, the problem is whether to perform all activities with state forces or perform some of the work by contract.

The private sector has developed a cost figure to examine these questions called "arbitrary manufacturing cost", which appears applicable in the maintenance and incidental construction context as well.⁽¹¹⁾ This approach takes somewhat of a short-run view of make-versus-buy questions and examines only the incremental cost of the activity. Basically, the calculation includes an estimate of labor, material, and other direct variable costs plus variable overhead costs. The rule applicable to the Department is that if some activities must be contracted because of capacity constraints, the resident engineer should choose to perform by state forces those activities where contract price exceeds estimated state force variable costs by the greatest margin until the capacity of state forces resources is fully used. The remaining work load should be contracted. If, on the other hand, all of the work load implied by the budget could be performed by state forces from a capacity viewpoint, then only those activities for which the contract price is less than the state force variable cost should be let for bid. The rationale of the rules is fairly obvious: Costs which are not variable are fixed and unavoidable; thus, they are of no consequence to any make-versus-buy decision, and only variable costs should be examined. The use of these variable cost rules does, however, require some caution. First, the time period over which costs are to be estimated must be that future period over which a contract for the activity (if let) would be in force. As has been alluded

to earlier, if the time frame is long, fewer costs are fixed and variable costs should increase. Secondly, extreme care must be exercised in the classification of fixed costs, because of the potential decision bias created by arriving at a state force variable cost estimate that is the result of fixed costs being overstated. (It is appropriate to note that if fixed costs are included in the estimate of the cost of the state force work, it would also have to be included as a cost of contracting.)

A hypothetical example may be used to clarify the importance of the variable cost rules noted above and to illustrate their usefulness as an aid in decision making. Assume that a residency has calculated the costs of mowing, machining shoulders, ditching, and guardrail maintenance and categorized them as shown in Table 2. Included are the direct labor costs and benefits, plus equipment costs and variable overhead costs. Also assume that potential contractors who are qualified with respect to quality, service, etc., have provided low bids as shown. Then, a cost calculation table like Table 2 can be used to treat both sets of circumstances. If the residency work force is employed at capacity, for example, it would minimize cost (if all other things are the same) to let the guardrail and shoulder work to contract and perform the mowing and ditching with state forces. Arranging the information as shown in Table 3 supports this decision. Recall that the decision rule says that at capacity, those activities where contract price exceeds state force variable cost by the greatest margin should be done by state forces until capacity is reached. Obviously, if all operations are done by state forces and costs are as shown in Table 3, total costs will be about \$12,000 greater than if only mowing (where contract price is \$4,000 greater than variable cost) and ditching (where contract price is only \$10 less than variable cost) are done with state forces. Other combinations of contract and state force activity would increase costs. If the residency can perform all of the maintenance activity the budget will support, following such a variable cost minimization rule could suggest changes in manpower levels over the long run.

Department's Cost Accounting

The previous section presented a variable cost minimization rule adopted from the private sector as a technique that could be useful to resident engineers in their analysis of state force versus contract decisions. In order to determine the transferability between the fixed and variable cost components outlined previously and the cost accounting activity codes used by the Department, the authors examined the cost reports available at the residency level, discussed them with several resident engineers, and reviewed the VDHT Activity Code Manual and the Time-Keepers Handbook, which outline the procedures the timekeeper must follow in the preparation

Table 2

VDH&T Hypothetical Maintenance Operations
Cost Example

Items	Examples					Total
	Mowing	Machine Shoulders	Ditching	Guardrail		
Labor & Equip.	\$75,000	\$ 93,000	\$23,000	\$3,200		\$194,200
Materials	0	0	0	3,200		3,200
Variable Overhead	2,000	1,600	630	300		4,530
Total Variable Cost	77,000	94,600	23,630	6,700		201,930
Fixed Cost	15,400	21,758	4,978	1,273		43,409
Total Cost	92,400	116,358	28,608	7,973		245,339
Contract Price	81,000	83,000	23,620	6,300		193,920
Excess Contract Price over Variable Cost	\$ 4,000	- \$ 11,600	- \$ 10	- \$ 400		- \$ 8,010

Table 3

Comparative Costs for All and
Selected Maintenance Operations

If all operations done by state forces, cost would be

Total variable cost.....	\$201,930	
Total fixed cost.....	43,409	
Total cost.....		\$245,339

If all operations were contracted, cost would be

Total contract price	\$193,920	
Total fixed cost.....	43,409	
Total cost.....		\$237,329

If mowing and ditching done in-house and machining shoulders and guardrail work were contracted, cost would be

Variable cost (Mowing).....	\$ 77,000	
Variable cost (Ditching).....	23,630	
Contract price (Shoulders).....	83,000	
Contract price (Guardrail).....	6,300	
Total fixed cost.....	43,409	
Total cost.....		\$233,339

of cost documents. These examinations reveal that while the expenditure codes can easily be used to identify direct variable costs, the separation of activity codes into variable overhead and fixed overhead is much more difficult. Yet, it is precisely that separation which is important to cost analysis. The authors have chosen, therefore, to delineate those activity codes which most clearly approximate fixed cost and provide some rationale for categorization; the remainder of expenditures fall into variable overhead and direct variable cost, and as such can be used to develop the type of analysis outlined in Table 3. A listing of the activity codes used by the Department is contained in Appendix A.

Fixed Costs

It was noted above that fixed costs are those not influenced by the volume of activity performed with state forces or by contract. Four general categories of fixed overhead were identified previously: general administration, general insurance, building, repairs and maintenance, and payroll, accounting, and associated labor. Activity codes reasonably fitting these categories are

for the most part those classified in the Activity Code Manual as General Activities, such as administration and supervision of the residency and/or district, including salaries of all office personnel (including additive rates), office supplies, utilities, and other costs incidental to administration, and testing suspense to the extent it is not chargeable to a particular activity or project. On the other hand, if testing or inspection can be identified with a particular activity or project, its cost is variable, not fixed, overhead. In addition to the above, all buildings and grounds expenditures of a non-capital outlay type (activity codes 031 through 039) are classified as fixed overhead whether they occur at the district, the residency, or the area headquarters level. Furthermore, the timekeeper's salary would be considered a fixed cost, with the exception of any of his charges which can be attributed to a particular activity (such as code 219, snow removal supervision), which are variable overhead costs. Similarly, the residency supervisor's salary and the area superintendent's salary, to the extent they cannot be identified with a particular activity, would be considered fixed costs. However, if any time charged to supervision (codes 299, 499, or 599) can be identified with an activity (even in the case of secondary maintenance where only the county is identified on the A-17 form), the expenditure is appropriately designated as variable cost. Within the general categories of ordinary maintenance, maintenance replacement, and incidental construction, there are general expense activity codes as well. For ordinary maintenance general expense categories (e.g., engineering, expendable equipment, etc.), the charges are made to the county allocation and crew number only, not to an activity of ordinary maintenance. The implication of this cost-accounting arrangement is that such items (codes 101 through 109) are overhead, and in fact should be considered fixed costs. With the possible exception of those portions of engineering (101) and the salary of the maintenance supervisor and his equipment, which hold the potential for being related to a specific activity or route, the items in the general expenses category of ordinary maintenance are fixed overhead costs. However, as noted previously, good cost analysis dictates that some effort be made to relate supervision of a non-general nature and engineering of a non-general nature to specific activities. Clearly, the resident engineer is the most qualified person to make such determinations.

For maintenance replacement and incidental construction, the cost-accounting arrangement for general expenses allows charging to an activity or route (activity codes 401 through 404 and 501 through 503). In this sense, the charges for these activities would, in general, be considered variable overhead. However, if testing, engineering, and inspection costs are expected to be

identical for a job whether it is to be done by state forces or by contract, they would be considered fixed overhead. If, however, only inspection costs are expected to be identical, then engineering and testing must be included as variable costs.

Variable Costs

The previous section on fixed costs implies those costs which should be considered as variable. In addition to those variable overhead costs (like 219, and some part of 299, 499, 599) direct variable costs are easily identified. They are the expenditures for personal services, materials and supplies, equipment, and other costs for activity codes 111 through 261 for ordinary maintenance; activity codes 411 through 484 for maintenance replacement; and codes 521 through 593 for incidental construction. Table 4 summarizes fixed and variable cost categories as defined in the sections above.

Table 4

Fixed and Variable Costs by
VDHT Activity Code

<u>Type of Cost</u>	<u>Code</u>
Fixed Overhead	002, 012, 013, 014, 015, 016, 017, 031-039, 101-106, Most of 109, Timekeepers' portion of 299.
Variable Overhead	219, part of 012, 109, 299, 499, 599, 401-404, 501-503 identifiable with an activity.
Direct Variable	Personal services, materials, equipment, other expenditure for 111-261, 411-484, and 521-593.

Quality

In the discussion of the broad view of cost, it was noted that quality and quantity considerations are appropriately examined apart from financial estimates of cost in make-versus-buy analysis. That is, they are nonfinancial considerations which are often extremely important, yet can only be weighed subjectively.

For some types of maintenance activity, guardrail repair for example, the quality of repair would not be expected to differ in any important respect whether it is done with state forces or performed through an outside vendor. In such cases, quality would not be an important consideration in the make-versus-buy decision. For activities where a significant quality difference is expected, however, experience in the private sector indicates that quality differences often outweigh all other factors.⁽¹²⁾ Implicitly, the question of quality comparability involves the examination of specifications. Clearly, the writing of specifications and the conformance to them will identify whether quality is comparable between performance by state forces and performance by outside vendors. If state forces have been used historically, a determination of quality comparability requires some experimentation with vendors on a trial basis. Interviews conducted during the study have revealed that two-year mowing and crack-sealing contracts and specifications are being used in Texas and Iowa for this purpose.

Arguments for Using State Forces

Two important arguments based on quality can be offered in support of performing work in-house. The first, and most frequently used argument is that the desired quality cannot be obtained from an outside vendor. As this pertains to Department maintenance activities, the argument translates to the proposal that the skill required to do the job is available only with state forces or that the equipment is so specialized that outside vendors find it unprofitable to invest in it. Rarely will an objective examination of the activity or the marketplace support this argument. If, however, the argument can be supported, the fact that no supplier can offer the desired quality should be some cause for concern because it may indicate that the Department's quality specifications are unnecessarily high. Furthermore, where activities have traditionally been monopolized by state forces, consideration should be given to whether the inability of suppliers to meet quality specifications is temporary.⁽¹³⁾ (This apparently is the view being taken in Texas and Iowa, since those states are letting long-term contracts on an experimental basis.)

The second argument relating to quality is that closer control of quality is required than using an outside vendor will allow. For Department maintenance activities this argument certainly is an important potential factor in make-versus-buy analysis. Of particular importance is the fact that the reputation of the Department depends upon the quality of maintenance work performed. If ill will results due to a lack of quality work traceable to vendor inattention, this may be justification for utilizing state forces. One might argue that any potential quality control problems can be overcome

through rigid inspection and the rejection of work falling below standard. Nevertheless, the cost of such a specification and inspection process cannot be overlooked by management. Thus, if close quality control is important because of the high visibility of the maintenance activity to the public, the use of state forces for control and inspection to minimize costs is certainly consistent with a private sector approach to make-versus-buy analysis.

Arguments for Using Contracts

Based on the literature, one can identify three arguments relating to quality which can be offered in support of contracting: a vendor is more skillful; outside suppliers, because of their specialization, can improve on quality; and the purchaser has greater flexibility.

One of the most compelling reasons for using a contractor is that he is probably more skilled at performing a specialized activity (such as bridge painting or underwater bridge inspections) than state forces, who perform the work as an infrequent activity. Furthermore, because of the large volume of work a specialized vendor does, he may have cost advantages compared to the use of state forces. Some may argue that if expertise is not maintained in-house, one is at the mercy of the contractor; however, market competition and the bid process significantly ameliorate this potential problem.

Regarding quality improvements in the provision of maintenance by contract, the production specialist will undoubtedly have a strong incentive to maintain a competitive position through quality improvements, particularly in the placement and use of materials. The fact that the Department has an internal research facility that commits significant effort to maintenance research seriously weakens this argument, however.

Flexibility cannot be overlooked as a strong argument for contracting. It is of particular importance for the Department because the highway industry undergoes frequent changes in both technology and materials prices. In such situations, a decision to perform an activity in-house may involve extreme costs in the long run if there is a change in quality requirements, technology, or materials costs. For example, maintenance overlays are performed by contract in Virginia. If this activity had been performed by state forces traditionally and all the required equipment had been purchased for each district, a decision to do more slurry sealing and less bituminous overlaying would have forced the Department into a somewhat inflexible position with respect to the paving equipment and crews.

Quantity

. . . it seems that arguments based upon quantity are seldomly so important as to justify, in themselves, making rather than buying. In most instances, therefore, quantity becomes a supplementary argument to add to a list of other arguments(14)

This quote summarizes quite well the view of many private sector managers that quantity considerations are relegated to a relatively minor role in most make-versus-buy decisions in the United States and Canada. In certain respects, however, quantity considerations would appear to be very important for the Department. Quantity considerations in the broad sense mean the ability to get the right quantity at the right time, and for maintenance activities that affect the safety of the motorist, such as snow removal, sign maintenance, signal maintenance, etc., quantity is very important. It does not follow necessarily that this importance of the quantity consideration implies that state forces should be used for such activities. In fact, if contractual arrangements are written in such a fashion as to provide the resident engineer with the appropriate level of coordination and control, as is currently the case for the rental of trucks and drivers for snow removal during peak periods, then quantity factors cannot be reasonably advanced as an argument for avoiding the use of contractors.

In addition to a consideration of whether or not the quantity of service desired can be supplied at the right time, the absolute amount of work involved can influence the make-versus-buy decision. If, for example, the quantity of work for a particular activity is so small that a supplier is not interested except as an expensive special order, the use of state forces is certainly a reasonable approach. Nevertheless, on an experimental basis some generalized maintenance contracts might be considered for certain stretches of road where the contractor would be responsible for several types of activities for a specified time period. (This experiment is being carried out in several states.) Thus, small quantities do not necessarily imply that it is desirable to use state forces. But, as noted above in the case of snow removal, large quantities do not necessarily imply letting a contract. A related aspect of quantity which will prove increasingly important is manpower planning. To the extent that contracting can be used to aid in the manpower planning management system, its flexibility cannot be overlooked by the Department.

THE STATE FORCE-CONTRACT MAINTENANCE DECISION PROCESS

Figure 1 is a flowchart outlining a proposed method of analyzing the state force versus contract maintenance decision process described in the preceding sections. It describes the steps which should be taken in estimating the financial cost of state force activities and shows the appropriate points at which to consider nonfinancial factors and capacity constraints. The process begins with an appraisal of nonfinancial factors such as manpower, expertise, and equipment constraints, proceeds through the financial cost estimation process with concentration on state force variable costs, and provides two decision rules for choosing between the use of a contractor or the use of state forces. The decision process described in the figure is applicable not only for maintenance but also for incidental construction.

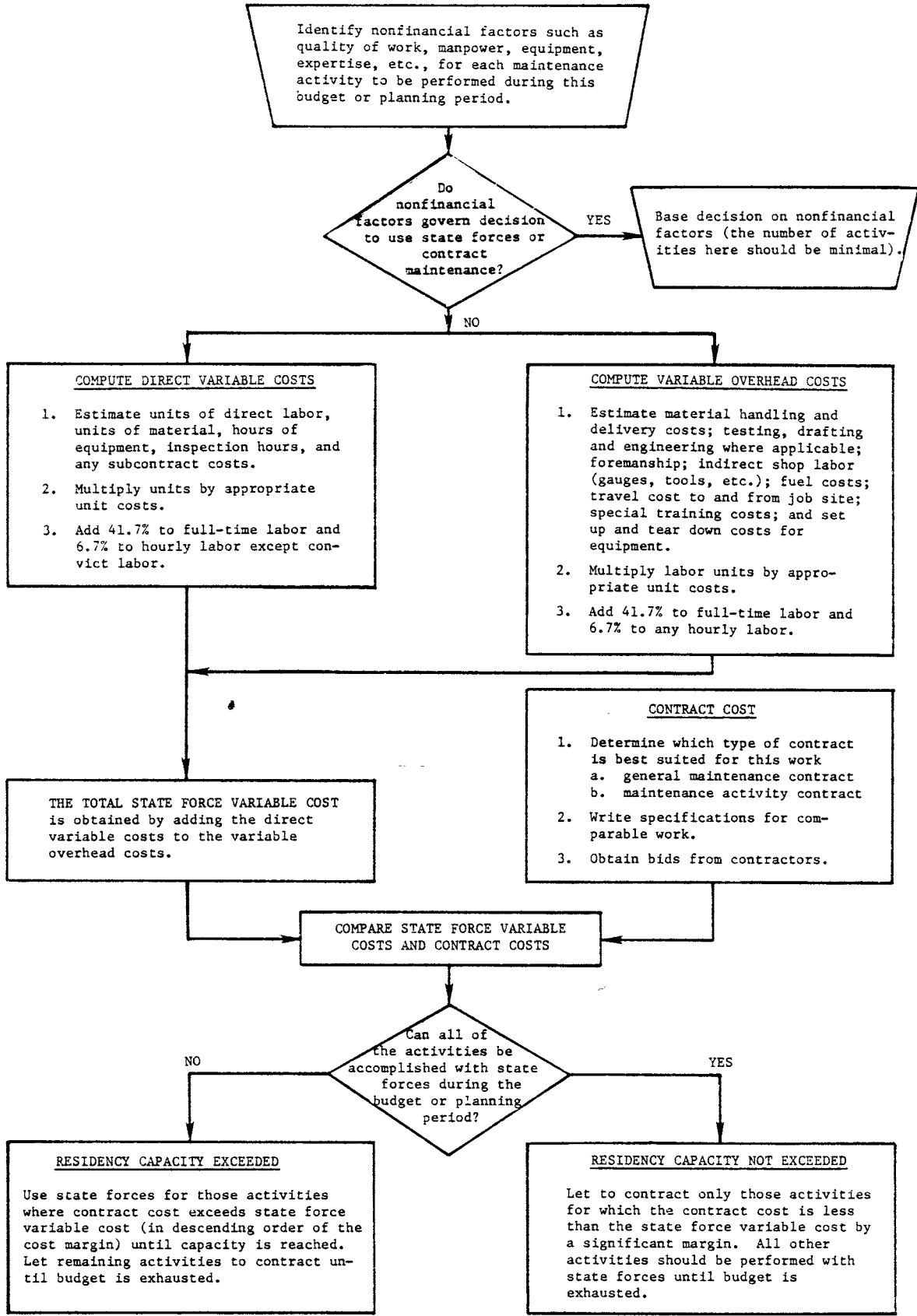


Figure 1. Flowchart for state force versus contract maintenance decision analysis.

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7. Gambino, Anthony J., The Make or Buy Decision, National Association of Accountants, New York, 1980, pp. 20-22.
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10. National Association of Accountants, Statements on Management Accounting Practices: Criteria for Make or Buy Decisions, June 1973, p. 6.
11. Culliton, op. cit., p. 22.
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14. Culliton, op. cit., pp. 53-54.

APPENDIX A

LIST OF THE VIRGINIA DEPARTMENT
OF HIGHWAYS AND TRANSPORTATION'S ACTIVITY CODES

Administrative and Support Activities

General

- 002 Administration and Supervision
- 012 Testing Suspense
- 013 Vacation
- 014 Sick Leave
- 015 Holiday
- 016 Compensatory Leave Taken
- 017 Compensatory Leave Earned
- 018 Outdoor Advertising
- 022 Purchase and Stores
- 024 Overhead (Nonadministrative)

Buildings and Grounds - Maintenance

- 031 Janitorial Services
- 032 Repairs to Buildings
- 033 Repairs to Utilities
- 034 Maintenance of Driveways, Parking Lots and Yards
- 035 Rental Quarters
- 036 Insurance
- 037 Repainting and Reroofing
- 038 Replacement of Utilities
- 039 Major Repairs of Grounds, Driveways and Parking Lots

Buildings and Grounds - Capital Outlay

- 041 Land
- 042 Grading and Fencing
- 043 Buildings
- 044 Driveways, Parking Lots, and Landscaping
- 045 Improvements and Additions to Buildings

Equipment Division Code

- 051 Maintenance of Rental Equipment
- 052 Services for Other State Departments
- 053 Services to Pool Cars
- 054 Work-in-Process, Rental Equipment Manufactured

198

Equipment Division Code (Continued)

055	Work-in-Process, Electrical Installations
056	Maintenance of Equipment, Buildings and Grounds
057	Equipment General Overhead
058	Work-in-Process, Miscellaneous
092	Stock Handling Cost

Ordinary Maintenance Activities

Ordinary maintenance is the function of preserving each type of roadway, structure, and facility as near as possible in its condition as constructed.

General Expense

101	Engineering
102	Inclement Weather
103	Expendable Equipment
104	Payments to Towns
105	Employee Education
106	Servicing Equipment
109	Administrative Overhead

Bituminous Surface Repair

111	Spot Sealing or Skin Patching of Road Surface
112	Premix Patching
113	Spot Reconditioning
114	Seal Cracks on Bituminous Surfaces
115	Treat Bleeding Pavements
119	Other Bituminous Surface Maintenance

Concrete Surface Repair

121	Patch with Concrete
122	Concrete Joints
123	Grouting, Undersealing or Pavement Jacking
129	Other Repairs to Concrete Pavement

Non-Hard Surface Roads

131	Patching Non-Hard Surface Roads
132	Machining Non-Hard Surface Roads
133	Applying Dust Palliatives
139	Other Non-Hard Surface Maintenance

Shoulder Maintenance Repair

- 141 Machine Non-Hard Surface Shoulders
- 142 Repair Non-Hard Surface Shoulder With Soil or Aggregate
- 143 Wedge Non-Hard Surface Shoulder With Bituminous Mixes
- 144 Repair Hard Surfaced Shoulders
- 145 Seal Cracks on Bituminous Shoulders
- 146 Machine High Shoulders — Hauling
- 149 Other Shoulder Care

Ditches and Drainage

- 151 Clean and Reshape Ditches by Machine — Hauling
- 152 Clean and Reshape Ditches by Machine — No Hauling
- 153 Hand Cleaning of Ditches
- 154 Clean and Repair Minor Drainage Structures
- 159 Other Drainage Care

Roadside

- 161 Erosion Repair, Minor Storm Related Work, and Removal of Minor Slides
- 162 Cleaning Right-of-Way
- 163 Dead Animal and Litter Patrol
- 164 Reseeding, Mulching, Sodding, and Resoiling
- 165 Picnic Areas, Waysides, and Rest Areas
- 166 Roadside Structures
- 167 Fences
- 168 Street Sweeping
- 169 Maintenance of Bike Paths

Vegetation Control

- 171 Tractor Mowing
- 172 Hand Mowing
- 173 Brush Cutting
- 174 Spraying Weeds or Grass
- 175 Trimming and Removing Trees
- 176 Spraying Brush

Signs and Traffic Control

- 181 Signs
- 184 Traffic Signals
- 185 Railroad Protection Devices
- 187 Reversible Lanes

Traffic Services and Operations

- 191 Repair or Reset Guardrail
- 192 Clean and/or Paint Guardrail
- 193 Historical Markers
- 194 Traffic Counts
- 195 Highway Lighting
- 196 Holiday Safety Service Patrol
- 197 Operation and Maintenance of Fog Warning and
Lighting System
- 198 Maintenance of Impact Attenuators

Snow and Ice Control

- 203 Snow Removal Expendable Equipment
- 211 Standby and Patrol for Snow and Ice Control by
State Forces and Equipment
- 212 Standby Time for Snow and Ice Control by
Hired Equipment
- 213 Snow Fence
- 214 Other Snow and Ice Control Support
- 215 Snow Removal and Ice Control by State Forces
- 216 Snow Removal and Ice Control by Hired Equipment
- 217 Availability Fee
- 219 Snow Removal Supervision

Structures

- 221 Repairing Substructures
- 222 Repairing Superstructures
- 223 Minor Repairs to Large Pipe Lines
- 224 Minor Repairs to Box Culverts
- 225 Waterproof Bridge Decks
- 226 Underwater Substructure Investigations

Drawbridges and Ferries

- 231 Operation of Drawbridges
- 232 Repair Toll Free Ferries
- 233 Operation of Toll Free Ferries
- 234 Repair Toll Ferries
- 235 Operation of Toll Ferries

Weigh Stations

- 241 Maintenance of Weighing Stations
- 242 Operation of Permanent Weighing Stations

Tunnels

- 251 Maintenance of Tunnels
- 252 Operation of Tunnels

Non-Roadway Related Expenditures

- 261 Bus Shelters

Supervision (299)

Maintenance Replacement Activities

Maintenance replacement is the function of restoring each type of roadway, structure, and facility as near as possible to its condition as constructed. Maintenance replacement activities are established to differentiate the major work from routine (or Ordinary) maintenance. It is defined as either those items involving continuous portions of roadway of 1,000 feet (305 m) or more, or the renovation of specific portions of roadway or structures requiring extensive or unusual work.

General Expense

- 401 Engineering
- 402 Inclement Weather
- 403 Expendable Equipment
- 404 Bridge Safety Inspections

Surface Replacement

- 411 Recondition Non-Hard Surface Roads
- 412 Recondition Hard-Surface Roads
- 413 Light Bituminous Retreatments
- 414 Heavy Bituminous Retreatments
- 415 Application of Plant Mix
- 416 Recondition Non-Hard Surface Roads
- 417 Repair and/or Replacement of Portland
Cement Concrete Pavement Joints
- 418 Portland Cement Concrete Pavement Slab Repairs
- 419 Linseed Oil Treatments

Shoulders, Turnouts, and Drainage

- 421 Reconditioning
- 422 Bituminous Retreatments
- 423 Drainage Structures
- 424 Extraordinary Cleaning of Major Outfall Ditches
and Channels

Roadside

- 431 Major Cut and Fill Washouts and Slides
- 432 Roadside Structures
- 433 Major Waysides and Rest Areas
- 434 Replacement of Right-of-Way Fences
- 435 Reseeding, Mulching, Sodding, and Resoiling
- 436 Replacement of Guardrail
- 437 Replacement of Existing Shrubs, Trees, etc.
- 438 Spray Brush, Weeds, or Grass

Signs

- 441 Signs
- 442 Traffic Signals
- 443 Highway Lighting
- 444 Paint Guide Lines
- 445 Paint Pavement Messages
- 446 Other Pavement Marking Expenses

Tunnels

- 451 Tunnels

Ferries, Structures, Foot Bridges and Public Landings

- 461 Repairing Substructures
- 462 Repairing Superstructures
- 463 Waterproofing Bridge Decks
- 464 Major Repairs to Ferries
- 465 Repairs and Replacement of Pipe Lines 48" (1.2 m)
in Diameter or Larger, Including Multi-Plate Pipe

Weigh Stations

- 471 Weighing Stations

Major Flood Damage Repairs

- 481 Roadway Repairs
- 482 Structure Repairs
- 483 Toll Free Ferries and Docks
- 484 Removal of Debris
- 489 Auxiliary Police Assistance

Supervision (499)

Incidental Construction

Incidental construction is any operation which changes the type, width, length, location, or gradient of a road, facility, or structure, or the function of building into, or adding to such road, facility, or structure, features not included in the original construction.

General Expense

- 501 Engineering
- 502 Inclement Weather
- 503 Expendable Equipment

Right-of-Way

- 511 Engineering
- 512 Land
- 513 Damages
- 514 Buildings
- 515 Fences
- 516 Right-of-Way Markers

Roadway Construction

- 521 Clearing and Grubbing
- 522 Earthwork, Excavation, Compaction, Including
 Shoulders and Slopes
- 523 Borrow: Excavation and Overhaul
- 524 Subgrade: Fine Grading and Treatment
- 525 Superelevation of Curves

Surface and Base

- 531 Admixtures: Chemical, Bituminous, Aggregate, or
 Portland Cement
- 532 Addition of Surface or Base Material
- 533 New Surface or Base Materials
- 534 Straight Bituminous Treatments
- 535 Penetration Treatment or Mixed-in-Place Treatments
- 536 Plant Mix Treatments

Shoulders and Entrances

- 541 Widening and/or Grading
- 542 Stabilizing
- 543 Bituminous Treatments

Drainage Structures

551	Excavation, Cofferdams, Pumping, and Backfilling
552	Substructure Including Footings
553	Superstructure
554	Protective Devices
555	Riprap
556	Large Pipe Lines Including Large Multi-Plate Pipes
557	Box Culverts

Drainage and Small Drainage Structures

561	Structures
562	Pipe Culverts Across Roadway
563	Pipe Culverts Across Entrances
564	Box Culverts and Cattle Passes
565	Concrete Curb and Gutter
566	Paved or Rubble Masonary Gutters
567	Riprap
568	Retaining Walls
569	Sub-drain, Tile Drains, Channels, etc.

Traffic and Pedestrian Services

571	Guardrail and Guide Posts
572	Route Markers, Section Markers, and Signs
573	Highway Lighting and Traffic Signals
574	Permanent Traffic Lane Stripes
575	Sidewalks
576	Snow Fences
577	Intersection Reconstruction and Channelization
578	Civil Defense Signs and Markers
579	Ice Detection Devices

Roadside Development

581	Grading, Sloping, and Obliteration of Scars
582	Soiling, Seeding and Sodding
584	Planting, or Replanting Trees, Shrubs, Care of Existing Vegetation, etc.
585	Drainage Channels
587	Waysides and Turnouts
588	Tree Wells and Walls
589	Rustic Guard

Toll-Free Ferries and Docks

591	Ferries
592	Docks, Slips, and Wharves
593	Stationary Equipment

Supervision (599)

APPENDIX B
SPECIAL PROVISIONS
FOR
GENERAL MAINTENANCE CONTRACT
STATE OF IOWA

NOTE: Conversions to equivalent metric units can be made as follows:

1 inch = 0.0254 meter

1 foot = 0.3048 meter

1 mile = 1.6093 kilometers

1 mil = 0.254 micrometer

1 square yard = 0.8361 square meter

1 acre = 4,047 square meters

1 cubic yard = 0.7646 cubic meter

1 gallon = 3.7854 liters

Special Provisions

Contract Maintenance

Project Management

The contractor shall provide a project manager to direct the work of his employees and to act as the contact person to coordinate with the engineer. The manager shall be available so he can be reached by telephone or other common communication media during work hours. There shall also be off-work-hour telephone number (s) where the contractor or his designated representatives can be reached at any time. A list of at least three contacts shall be furnished in priority order, designating who should be called if the project manager is not available.

Scope of Work

The work required of the contractor shall consist of those contract items listed as bid items for individual functions in the schedule of prices, plus "Other Work" will be directed by extra work order. The "Other Work" category may include labor only for assistance in the state's snow removal or other emergencies.

The descriptions of the work for individual functions are included in Appendix A, including measurement and payment. Appendix A may include some functions that are not a specific part of this contract.

"Other Work" includes, but is not limited to the following functions. Where indicated, the descriptions of the work of these functions are also included in Appendix A.

625 - Other surface maintenance.

Pavement deslickling, surface grinding, linseed oil sealing, rebuilding curbs, edge sealing and winter sealing, and other items of surface maintenance not covered elsewhere.

643 - Other shoulder maintenance.

Experimental projects, and items of shoulder maintenance not covered elsewhere.

647 - Cut brush and trees.

See Appendix A.

650 - Erosion control.

See Appendix A.

653 - Other roadside maintenance.

Maintain trees and plantings, maintain frontage roads and extended driveways, and other items of roadside maintenance not covered elsewhere.

657 - Culvert maintenance.

Clean, repair, relay or install culverts, end sections and letdown devices. Includes repairs to barrels, aprons, wing walls, flumes, drop inlets, and filling voids around culvert structures.

659 - Drain tile, catch basins and inlets.

Install, maintain, and clean drainage tile, sub-drains, inlets, catch basins, and storm sewers normally maintained by the state.

660 - Drainage.

Maintain and restore drainage within the right-of-way.

685 - Repair bridge structures.

See Appendix A.

689 - Maintain bridge waterways.

Removal of debris from bridges, repair wing dams, replace rip-rap, and excavation or placing fill at waterways.

692 - Other bridge maintenance.

Includes items of bridge maintenance not covered elsewhere.

Labor and Equipment Bid Items

The Other Work, Labor, and Other Work, Equipment, items on the schedule of prices will be used in payment for labor and equipment utilized in the performance of "Other Work". The contractor's labor used outside of normal work hours at the direction of the engineer shall be paid for at the rate of 1-1/2 times the contract rate for labor.

The contract price for equipment used in "Other Work" will be the contract percentage of the rental rate shown in the 1981 "Rental Rate Blue Book for Construction Equipment". The rates used in negotiating extra work orders will be the current rate for the make and size actually used. The rates used on items of equipment shall be extended using the contract percentage of Blue Book price.

The proposal will show several items of equipment, a number of hours, and an approximate Blue Book rate. These are estimates for typical equipment which will be used as part of the procedure for determination of low bid. The contract percentage of Blue Book rate will be applied to all equipment utilized in the performance of "Other Work", even though not listed.

Specifications

The Standard Specifications, Series of 1977, where appropriate, and the supplemental specifications and special provisions identified in the contract documents shall apply to the work of this contract.

Materials

All materials incorporated into the work shall meet the requirements of Part IV of the Iowa Standard Specifications for Highway and Bridge Construction. Certification by the supplier, materials from approved stockpiles, or testing by private laboratories will be acceptable.

Materials required to complete "Other Work" or extra work may be furnished by the State at the discretion of the engineer. If furnished by the contractor, payment will be included in the negotiated price, as specified in the Standard Specifications, Article 1109.04 B2.

Bid Prices

The prices bid for the individual functions will include all labor, equipment, and materials used in accomplishing the work, unless otherwise specified in the individual function specifications.

Incidental Items

The contractor's overhead costs are to be included in the mobilization item. Traffic control for operations, travel time to and from the work site, all tools, materials, and supplies necessary to support the operation and any other unforeseen expenses incurred in performance of the routine work shall be considered incidental to the work.

Public Relations

The nature of highway maintenance work places the workman in close contact with the public, as both traffic and land owners. Contacts made by the public to complain or report a condition, such as driveway condition drainage, etc., shall be referred to the Resident Maintenance Engineer or his designated representative.

Regular Work Hours

Routine maintenance operations will normally be performed between 8:00 a.m. and 5:00 p.m., Monday through Friday, except on State holidays. Work performed outside these hours at the contractor's option will be with the engineer's approval and at the bid price.

Traffic Control and Safety

Traffic control to guide traffic around and through a maintenance operations area and to protect workmen shall be in accordance with the 1979 Iowa Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), the 1976 Iowa Construction and Maintenance Traffic Control Handbook and Appendix A of the Maintenance Standards Manual entitled "Traffic Control for Maintenance Operations". In cases where the documents differ in application of traffic control devices, the MUTCD shall control. In special circumstances where none of the standards apply to the operation to be performed, the contractor shall consult with the engineer for guidance and instruction.

Equipment working on the surface or shoulders shall be equipped with a yellow rotating beacon which flashes a minimum of 60 times per minute. Mower tractors may use a yellow flashing strobe light in lieu of the rotating beacon. Mounting heights or locations of lights are shown in the Maintenance

Equipment Lighting Manual. Where applicable, slow moving vehicle emblems shall be used in accordance with the Code of Iowa.

The cost of providing all traffic control devices for contract maintenance operations including installation and removal shall be considered incidental to other contract items for specific functions. No additional compensation shall be made for any traffic control work required for these functions.

Parking of contractor vehicles and equipment will be permitted within the right-of-way only at locations designated by the engineer but in no case shall they be closer than 30 feet to the roadway. Any damage done to trees, shrubs, and vegetation within areas permitted for parking will be corrected at the contractor's expense. Parking of private vehicles within the right-of-way is prohibited at all times.

Contractor's personnel shall wear orange safety vests when working at any place on the right-of-way and shall wear hard hats when working on pavement or shoulders. This is a minimum and should not be construed to supersede the contractor's other safety work rules.

Highway Maintenance Work

Planning and scheduling maintenance work is a very important part of the operation. However, plans and schedules are oftentimes necessarily altered due to weather conditions, emergency operations to protect the traveling public, and other unforeseen events which will occur. The contractor will need to be totally flexible to respond to these conditions on very short notice. An important part of maintenance work is becoming familiar with the highways to be maintained and the features of this highway that are included in the contract.

Scheduling Work

All work performed, including procedures, must have prior approval of the engineer or his designated representative according to job orders or extra work orders. This approval, scheduling, and issuance of job orders will be at regular bi-weekly meetings, or at other times made necessary by unforeseen events, between the contractor and the engineer or their representatives, at a mutually agreed upon location. The approved work schedule may be changed if acceptable to the engineer, or a change may be directed by the engineer if determined necessary. The attached Table No. 1 indicates the time of the year that the various types of work have historically been performed or required.

Reporting Accomplishment

The contractor will report all work performed by function and route number. Surface, shoulder, and bridge maintenance accomplishment will also include the milepost location of the work. All necessary reporting forms and milepost reporting instructions will be provided by the State. This report shall be submitted with the monthly invoice.

Payment

Payment for work accomplished will be made on receipt of an invoice from the contractor at the end of each month. The invoices shall be accompanied by the accomplishment report and copies of materials reports or certifications. The contractor shall certify the invoice to be just and unpaid.

For the quantity of work involved in individual functions for which there is a contract item, the contractor will be paid the contract price therefor.

For the quantity of work involved in "Other Work", the contractor will be paid on the basis of the contract prices for Other Work, Labor, and Other Work, Equipment.

Contract Period

The contract period will be from January 1, 1982, until June 30, 1983

Mobilization Bid

The contract amount for mobilization shall be considered to include all overhead items and those items listed as incidental to the work, according to the Supplemental Specification for Mobilization.

Estimated Quantities

The quantities shown on the schedule of prices are estimates only. The actual quantities determined necessary may vary considerably. Section 1109.03 of the Standard Specifications will not apply.

Bid Prices

Contract prices shall be firm bids for the duration of the contract.

Coordination

The bidder is advised that other activities may be performed or authorized within the project limits by the DOT during the contract period. When appropriate, the engineer will decide questions concerning disputed or mutual rights between the contractor and the DOT or other authorized parties.

Damages to Highway, Appurtenances, or Utilities

Any damage to highway facilities or utility installations due to the contractor's operations shall be repaired at the contractor's expense.

Manuals and Instructions

The documents listed will be made available for examination by prospective bidders to assist in bid preparation and as guides for work performances.

Maintenance Standards

Maintenance Policies and Procedures

Equipment Lighting Manual

Milepost Reporting Instructions

Definitions

1. Mobilization Costs - Costs incurred by the contractor for office, communications, equipment, movement, organizational work and all other overhead and incidental costs.
2. Other Work - Work of a general nature, not included in contract items, and specific jobs. To be performed as directed by the engineer.
3. Regular Work Hours - 8:00 a.m. to 5:00 p.m., Monday through Friday.
4. Function - One of the numbered items appearing in the schedule of prices which describes the specific work operation.
5. Surface Types - For reporting purposes and plat references, surface types included are as follows:
 - Unit 10 - Portland Cement Pavement
 - Unit 30 - Inverted Penetration - no base
 - Unit 40 - Inverted Penetration on-base
 - Unit 80 - Portland Cement overlaid with Asphaltic Concrete
 - Unit 90 - Asphaltic Concrete - base
6. Milepost - Mileage from beginning of route, posted each mile on right side and numbered from west to east and from south to north, depending on cardinal direction of the route.
7. Job Order - A written directive to the contractor authorizing specific routine work to be performed.
8. Extra Work Order - To be used to authorize the contractor to perform "Other Work", or other unforeseen special functions.
9. Standard Specifications - The Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction, Series of 1977, and revisions listed on the proposal.

10. High Type Mix - Hot asphaltic concrete or Sylvax premix or equivalent.
11. Blue Book - The 1981 Rental Rate Blue Book for Construction Equipment.

TABLE NO. 1
HISTORICAL MONTHLY DISTRIBUTION OF WORK BY PERCENT

Function No.	Description	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
SURFACE													
609	Spall Patching	7	6	5	5	7	4	5	4	14	17	14	12
610	Blow-up Rpr. & Mud Level	31	11	7	5	7	4	1	1	1	4	5	23
611	Machine Level	15	15	16	16	9	1	0	0	0	2	7	20
612	Crack Seal	3	3	3	2	4	7	7	13	17	18	15	8
613	Pav. Patching FD	10	7	15	27	13	4	1	0	0	1	5	17
614	Seal Coat	12	19	23	19	9	2	0	0	0	2	5	9
618	Strip Seal	20	15	18	13	4	0	0	0	1	1	9	19
619	Burn/Plane	19	16	16	9	7	6	3	1	3	4	5	11
620	Broom & Sweep	10	10	7	7	6	3	2	1	2	10	23	19
621	Raise Pavement	7	7	9	13	16	3	0	0	0	3	19	23
690	Exp. Relief Jts.	9	12	10	9	9	7	4	3	5	8	12	12
625	Other	12	12	11	9	7	5	1	3	3	10	13	14
SHOULDERS													
628	Rpr. Sh. W/Bit. Mix	13	13	19	9	13	3	2	1	1	2	6	18
629	Seal E.R. & Pvd. Sh.	12	14	17	23	15	5	1	0	0	1	4	8
632	Fill Long. Jnts.	4	8	15	7	11	5	6	6	8	17	2	11
633	Pvd. Sh. Rpr.	16	28	20	8	6	1	1	0	0	6	3	11
634	Repair W. Agg.	8	11	9	10	13	7	1	0	4	15	10	12
636	Now Sh. & Med.	15	18	15	15	5	0	0	0	0	0	0	32
638	Hnd. Mowing	21	20	15	11	4	1	0	0	0	0	3	25
640	Bld. Sh.	6	8	10	12	14	7	2	0	2	9	16	14
641	Rebuild Sh.	8	11	12	24	16	6	0	0	0	2	8	13
643	Other Sh. Mt.	7	10	7	11	12	5	4	1	4	10	12	17
ROADSIDE													
645	Rdsid. Mowing	27	31	21	9	3	0	0	0	0	0	0	9
646	Foliage Spraying	15	6	3	7	2	0	0	0	0	1	14	52
647	Cut Brush & Trees	2	2	2	2	5	23	22	14	10	8	6	4
649	Litter Removal	2	1	1	4	4	5	3	1	2	29	42	6
650	Erosion Control	10	12	13	8	10	10	3	0	0	2	15	17
653	Other Roadside	7	5	6	8	12	10	6	3	4	9	14	16
DRAINAGE													
655	Clean Ditches	11	12	13	13	14	4	1	1	0	1	12	18
657	Culvert Maintenance	11	8	8	12	14	6	1	0	4	7	13	16
659	Dr. Tile, Catch Basin & Inlet	6	12	10	13	11	6	1	0	3	6	16	16
660	Other Drainage	4	4	4	30	5	7	5	2	7	16	7	9
BRIDGES													
683	Deck Repair	19	21	15	12	8	1	0	0	0	1	6	17
684	Cln. Deck, Piers, Abts., Jntc.	6	6	12	13	7	5	3	1	3	13	17	14
685	Repair Structure	9	13	13	12	11	6	1	2	2	5	11	15
687	Br. Painting	14	7	10	18	8	3	0	0	0	1	18	21
689	Maint. Waterway	6	11	16	8	8	9	5	2	1	6	14	14
692	Other Br. Mt.	6	10	9	6	32	8	4	2	5	6	5	7

APPENDIX A

FUNCTIONS

<u>Function</u>	<u>Title</u>
600, 609, 611	Patching and Leveling with ACC and Bit. Premix
612, 643	Fill Joints and Cracks with Bit. Material or Joint Sealing Compounds
613	Full Depth Pavement Replacement
614, 629	Seal Coating
618	Strip Sealing
619	Burn/Plane Surface
620	Brooming and Sweeping
621	Raise Pavement
628	Repair Shoulders with Bituminous Mix
633	Paved Shoulder Repair
634	Shoulder Repair with Aggregate
636	Mow Shoulders and Medians
638	• Hand Mowing
640	Blade Shoulders
641	Rebuilding Shoulders with Earth
645	Roadside Mowing
646	Foliage Spraying
647	Cut Brush and Trees
649	Litter Pick Up
650	Erosion Control
655	Clean and Restore Roadside Ditches
683	Deck Repair
684	Clean Decks, Piers, Abutments and Expansion Joints
685	Repair Bridge Structures
687	Bridge Painting
690	Pressure Relief Joints

PATCHING AND LEVELING WITH ASPHALTIC CEMENT CONCRETE AND BITUMINOUS PRE-MIX

REF. MAINTENANCE FUNCTIONS 609 (TYPE A), 610 (TYPE B), 611 (TYPE C)

Purpose

To repair small isolated deteriorated spots or holes in roadway, bridge and paved shoulder (Type A), make temporary blowup repairs or hand leveling (Type B, and machine leveling with asphaltic cement concrete or bituminous pre-mix (Type C).

Description

Type A - Filling spalls, small corner breaks, pitting, popouts, raveling and joint failures with high type bituminous pre-mix, as approved by the Engineer.

Type B - Hand leveling of dips, sags, depressions and areas of severe surface deterioration with hot asphaltic cement concrete or regular bituminous pre-mix. Temporary repair of pavement blowups to accommodate traffic until pavement conditions stabilize and/or permanent repair can be made.

Type C - Placing asphaltic cement concrete with laydown machine on unit 10, 80 and 90 surfaces or bituminous pre-mix with motor grader on unit 30 and 40 surfaces to level uneven surfaces, or cover large areas of severe surface deterioration.

Quality

Type A - Except when patching under emergency conditions all loose materials shall be removed from the area to be patched. Edges of the hole will be cut nearly vertical to a depth of approximately 1", and the hole will be dried and a tack coat applied. Patches will be compacted with a hand or mechanical tamper. The compacted surface of the patch shall not be lower than nor more than 3/8 inch higher than the adjacent pavement surface.

Under emergency conditions the patches will be done in a manner to alleviate the emergency conditions as expeditiously as the conditions permit.

Type B - When leveling dips, depressions, sags or covering areas with severe surface deterioration, the area to be covered shall be cleaned and tack coat applied. The patch shall be placed in lifts not to exceed 2 inches. Each lift shall be compacted with tamper or roller. The surface of the patch shall not deviate from the surrounding surface more than 3/8 inch when checked with a straight edge.

Temporary blowup and emergency pothole repair shall be performed in a manner as to provide the maximum safety and convenience for the traveling public that is possible under the existing conditions.

Type C - The area to be covered under this activity shall be cleaned, holes filled (per Type A) and the surface shall have tack coat applied. Materials shall be placed in lifts not to exceed two inches. Compaction and profile shall be as directed by the Engineer.

Procedures

All holes being filled and areas being covered shall be free of unsound materials, cleaned and tack coat applied. No tack coat is to be applied when using high performance pre-mix. Incidental shoulder work will be scheduled as shoulder maintenance activity. Temporary pavement marking will be placed as directed by the Engineer. Sealing of runouts will be incidental work as directed by the Engineer.

Materials

One-half inch maximum aggregate size Type A, B or high type commercial asphaltic cement concrete as approved by the Engineer. Regular bituminous pre-mix (Standard Specifications for Highway and Bridge Construction, Part IV Supplement, Materials, Section 4202 dated 1977). High performance pre-mix (special provision SP-324 dated SEPTEMBER 19, 1980)

Measurement and Payment

Measurement of this activity will be by ton of bituminous mix placed in patches. Type A repair will have two separate bid items for regular and high performance pre-mix. Type B and C repair will each be separate bid items.

Temporary pavement marking, when required, is incidental.

FILL JOINTS AND CRACKS WITH BITUMINOUS MATERIAL OR JOINT SEALING COMPOUNDS

FUNCTION 612 AND 632

Purpose

To provide flexible material in joints and cracks including the joint between the slab and paved shoulder, to prevent entry of moisture and foreign materials.

Description

Includes cleaning of the crack or joint, the application of the sealing material and blotting with sand when necessary.

Quality

Cracks and joints shall be filled to between 1/4 and 1/2 inch below the surface unless the Engineer specifies otherwise.

Cracks and joints open 1/2 inch or more shall be choked to approximately 1 1/2 inch below the surface with sawdust, vermiculite, ground corn cobs, etc. to reduce the amount of sealant required. (Sand may be used to choke cracks on flexible pavements.) Any spills or overfills will be blotted with sand to avoid tracking.

Procedures

Cracks being sealed with emulsion or other liquid bituminous material approved by the Engineer will be thoroughly cleaned.

Materials

Emulsion and liquid bituminous material shall comply with standard specifications.

Measurement

Measurement will be by gallons of sealant placed in crack. Bid item will include blotting and choking materials as incidental. Payment will be at the unit bid price.

018

FULL DEPTH PAVEMENT REPLACEMENT

FUNCTION 613

Purpose

To make permanent repair of pavement structure.

Description

Full depth patching of both rigid and flexible pavements with either P.C. or A.C. concrete. Includes removal and disposal of old pavement, any necessary base repair, and edge seal when required.

Quality

Removal of old pavement, hole preparation, finishing, and curing shall be performed in compliance with the specifications for pavement repair, Supplemental Specification 886.

Procedures

In general, work should be planned and materials used which will not require overnight traffic restrictions and signing. Any deviation must receive concurrence of the Engineer.

Measurement and Payment

Measurement will be by square yard of patch and paid for at the contract unit price. The price bid will cover either P.C. or A.C. as directed by the Engineer.

SEAL COATING
FUNCTIONS 614, 629

Purpose

To correct map cracking, abrasion, top lift raveling, checking, dry surface, weathering, wheel rutting, seal patches, bituminous edge rut treatments and bituminous shoulders and to increase skid resistance.

Description

Inverted penetration seal on roadway or shoulder surface using emulsified asphalt and aggregate or emulsified asphalt slurry mix.

Quality

This work shall comply with special provisions for seal coat contracts or Supplemental Specification 894 for slurry seal contracts.

Procedures

Small areas should be sealed in uniform rectangular patches.

Measurement and Payment

Work will be measured in square yards of surface sealed and paid for at the contract unit price.

STRIP SEALING

FUNCTION 618

Purpose

To seal centerline and pavement widening cracks.

Description

Application of slurry or inverted penetration seal in strips of from 8 inches to 12 inches wide on centerline or pavement widening crack.

Quality

Any spalls or popouts should be patched with bituminous mix as type "A" patches, before seal material is applied.

Procedures

A squeegee box as described in No. 1 Section XVIII of Maintenance Policies and Procedures shall be used to apply CRS-2 emulsion in the crack. The emulsion shall be heated to 140^o - 160^o F. Blotting sand shall be applied to the crack immediately behind the squeegee. Special signing to be accomplished by the contracting authority, is required when traffic markings will be obliterated. Close coordination with the local area supervisor is necessary.

Materials

CRS-2 emulsion complying with standard specifications shall normally be used. The Engineer may approve use of alternative materials.

Measurement and Payment

This activity will be measured in mile of crack sealed and payment will be at the contract unit price.

BURN/PLANE SURFACE

FUNCTION 619

Purpose

To remove humps, excess bituminous ripples, heaved joints, and to eliminate wheel ruts.

Description

Heating and/or planing of bituminous surfaces.

Quality

After planing heaved joints, rippling or shoving on A.C. resurfacing, the area shall be sealed with CRS-2 emulsion and immediately blotted with sand.

Procedures

Material planed off shall be used on adjacent edge ruts or shoulders or picked up and stored as directed by the Engineer. The Engineer may approve alternate methods for removing humps. Prior to burning within the corporate limits of any city, the contractor shall notify the city authorities and utility companies.

Measurement and Payment

Measurement will be by square yard burned and/or planed. Payment will be at the contract unit price.

1.22

BROOMING AND SWEEPING

FUNCTION 620

Purpose and Description

Brooming or sweeping surfaces with mechanical broom or sweeper to either clean surfaces, gutters and intersections, or to redistribute cover aggregate.

Procedures

The contractor shall be responsible for disposal of the sweepings. Before brooming, wind conditions and the amount of dirt raised must be considered.

Measurement and Payment

Measurement will be in hours of sweeping. Payment will be at the unit rate bid. The contractor shall report the number of manhours utilized in performing this item to the Engineer at monthly intervals.

RAISE PAVEMENT

FUNCTION 621

Purpose

Raise pavement and/or fill voids under the pavement.

Description

Correction of surface profile as a result of subsurface cavities by pressure injection of a portland cement, soil and water mixture, or the filling of subsurface cavities without surface profile correction as directed by the Engineer.

Quality and Workmanship

All known voids shall be filled. When raising pavement, the finished grade will not vary by more than 1/2 inch from string line.

Procedure

Upon determination of areas to be corrected as to type and size, holes for injection of the mixture are to be drilled through the pavement. The recommended procedures as outlined by the manufacturer for the equipment used shall be followed for best results.

Upon completion of this work the surface shall be cleaned and any edge ruts or shoulder damage shall be corrected before leaving the area.

Materials

Pumping mixture shall be as recommended by the manufacturer for the equipment used and as approved by the Engineer.

Measurement and Payment

This activity shall be measured in cubic yards of mixture placed for pavement raised and/or cavities filled. Unit price shall include all operations to complete this activity including preparation of the mixture, drilling the holes and clean up of the work site. Payment will be made at the contract unit price.

024

REPAIR SHOULDERS WITH BITUMINOUS MIX

FUNCTION 628

Purpose and Description

To fill edge ruts on unpaved shoulder, build wedges on bituminous or paved shoulders to correct drop off between pavement and shoulder, leveling and repair of shoulders other than full depth repair, using bituminous pre-mix.

Quality

Bituminous pre-mix as approved by the Engineer shall be used to fill edge ruts where traffic, wind erosion or washing on unpaved shoulders makes treatment with aggregate impractical. Treatment shall be in uniform width as directed by the Engineer.

A wedge of asphaltic cement concrete mix shall be placed on paved shoulders along the pavement if shoulder settlement has resulted in a drop off of more than two inches. The wedge will be placed at a nominal 6:1 slope.

Procedures

Areas of edge ruts to be treated on unpaved shoulders shall be reasonably free of loose material, areas shall have a tack coat applied, bituminous pre-mix placed in designated areas and spread evenly. Compaction will be as directed by the Engineer.

Areas to receive wedge treatment on paved shoulders shall be reasonably free of loose materials, and a tack coat shall be applied. Asphaltic cement concrete shall be placed in designated areas to a uniform slope. Compaction shall be as directed.

Materials

Bituminous pre-mix as approved by the Engineer shall be used to fill edge ruts.

1/2" size Type A, Type B, or high type commercial asphaltic concrete as approved by the Engineer shall be used to construct the wedge on paved shoulders.

Measurement and Payment

Measurement of this activity will be by ton of approved materials placed in the edge rut or the wedge. Payment will be at the contract unit price.

PAVED SHOULDER REPAIR

FUNCTION 633

Purpose

To repair damaged areas in paved shoulders.

Description

Full or partial depth repair or replacement of paved shoulders with A.C. or P.C. concrete.

Quality

In making repairs to higher type shoulders, replacement shall be in kind. Rumble strips on shoulders shall be replaced when disturbed by patching operations. Base repairs where necessary shall be incidental to this activity.

Procedures

Material removed in patching and base repair will be disposed of as directed by the Engineer. Loose and unsound materials shall be removed and holes squared up. Holes to be filled with asphaltic cement concrete shall have a tack coat applied to the hole. Compaction of material placed shall be as directed by the Engineer.

Materials

Materials shall conform to the standard specifications.

Measurement and Payment

Measurement will be by square yard of surface repaired. Payment will be at the contract unit price.

SHOULDER REPAIR WITH AGGREGATE

FUNCTION 634

Purpose

To replenish surfacing on shoulders and mailbox turnouts. To fill edge ruts and shoulder washes.

Description

Application of aggregate on unpaved shoulders and mailbox turnouts within the normal shoulder width.

Quality

Care shall be exercised to minimize the amount of aggregate placed on the slab. No piles or windrows of aggregate shall be left on the shoulders. Edge rut and general shoulder application shall be compacted as directed by the Engineer. Shoulder surface shall not be finished higher than 1/2 inch below pavement surface. Shoulder slope and width of repair shall be as directed by the Engineer.

Procedures

Application methods may range from continuous application with spreaders to dumping and spreading with blades or shovels.

Repair of edge ruts on other than stabilized shoulders may require an application of bitumen at the nominal rate of 0.3 gal. per sq. yd. prior to placing aggregate if directed by the Engineer. Surfacing of private drives outside the shoulder line is not permitted while performing this activity.

Measurement and Payment

Measurement will be by ton of aggregate placed on shoulders. Payment will be at the contract unit price.

The application of bitumen prior to the aggregate, when required, will be paid for as a negotiated item.

MOW SHOULDERS AND MEDIANS

FUNCTION 636

Purpose

To delineate the shoulder edge, provide sight distance and aid in snow removal and reducing snow accumulation.

Description

This work shall consist of mowing the vegetation on non-paved shoulders and a strip along the edge of shoulder.

Quality

The mower cutting height shall be set such that after completion of the mowing operation the height of the remaining stubble will average six inches plus or minus one inch. More than one pass of the mowing unit may be necessary to accomplish the mowing. Where more than one pass of the mowing equipment is required, successive passes shall be lapped so as not to leave any uncut vegetation. Bunching or windrowing the mowed vegetation will not be permitted. Where wet soil conditions result in rutting of the foreslope, mowing shall be suspended. the speed of the mowing equipment shall not exceed the ability of the mower to cut cleanly and completely.

Procedures

Mowing equipment shall consist of a tractor with a sickle type mower, an underbody rotary mower, a gang type rotary mower, or other types approved by the Engineer. Rotary mowers shall be equipped with a suction type blade and safety chains or other approved protective devices. Sickle bar mowers shall have protective shields on all sections. Broken sections shall be replaced to insure a clean, smooth cut. Different types of mowers may be used on the same project as approved by the Engineer.

The shoulder vegetation and a swath adjacent to the shoulder should be mowed when 50% of the vegetation reaches a height of 14 inches or greater. The swath adjacent to the shoulder will range in width from 5 feet to 15 feet as specified by the Engineer. Generally the wider width will be limited to the last mowing in the fall and will occur after September 1.

Where W-beam guardrail is present, in the median, all vegetation within the specified limits shall be mowed plus a minimum of five feet on all sides of the guardrail. Where cable guardrail, W-beam guardrail or guard posts are present, along the outside shoulder, all the vegetation between the edge of the shoulder and a point 5 feet beyond the guardrail or posts shall be mowed.

Hand equipment will be required for areas inaccessible to other equipment for trimming around and under delineator posts, sign posts, guardrail, bridges, culverts, or other obstructions and shall be accomplished in accordance with specifications for function 638.

028
Mowers shall not be operated on slopes steeper than 2.5 to 1.

On four lane divided roadways mowing of the shoulder and adjacent swath shall include the median shoulders as well as the outside shoulders. Median crossover slopes shall be mowed.

Mowing shall progress in the same direction as traffic when mowing along the mainline and right ramp shoulders. Mowing along the left ramp shoulder in the direction opposite the flow of traffic will be permitted. Mowing operations shall be conducted such that the equipment does not encroach in the travelway except where shoulder width does not permit. In these situations encroachment will be permitted in conjunction with proper traffic control. When mowing behind guardrail, the direction of travel may be opposite that of adjacent traffic.

Measurement and Payment

Shoulder and median mowing shall be measured in feet based on the centerline length and the width specified, and the area calculated in acres. Deductions will be made for bridges or other areas not mowed. Areas around guardrails beyond the specified limits shall not be measured separately. Any mowing accomplished with hand equipment will not be measured or paid for separately.

For the number of acres calculated, the contractor will be paid the contract unit price. This will be considered full compensation for accomplishing the mowing in accordance with the contract documents including mowing around guardrails, signs, delineators, drainage structures, bridges and crossovers.

HAND MOWING

FUNCTION 638

Purpose

To maintain visibility of roadside appurtenances in areas where tractor mowing has occurred.

Description

This work shall consist of cutting vegetation with hand sickle, scythes, string trimmers, or hand mowers to control vegetation around signs, delineators, guardrail, bridge ends, plantings, and other areas where cutting is necessary but cannot be cut with tractor mowers.

Quality

Vegetation which is mowed with hand equipment shall be no higher than the surrounding vegetation which has been cut with tractor mowers.

Procedures

Where the area behind guardrail is inaccessible with tractor mowers, the vegetation behind the guardrail shall be mowed with hand equipment to a minimum width of 2 feet.

The contractor shall report, at monthly intervals, the manhours of labor incurred in accomplishing hand mowing.

Measurement and Payment

Hand mowing shall not be measured or paid for separately but rather shall be considered incidental to "Mow Shoulders and Median", function 636.

BLADE SHOULDERS

FUNCTION 640

Purpose

Maintain even surface and proper slope on earth, stone or stabilized shoulders.

Description

Blade shoulders with motor grader, tractor mounted blade or towed grader, as required to maintain a relatively smooth surface and to remove aggregate build up near the pavement edge that interferes with surface drainage or inconveniences traffic. Includes blading of approaches and driveways within normal shoulder width to prevent a build up of material on the shoulder.

Quality

Shoulders are to be maintained at a uniform cross slope. Where sufficient shoulder material is present the cross slope shall not be flatter than 1/2 inch drop per foot of shoulder width. Approaches are to be maintained as close as possible to as built cross section to facilitate proper drainage.

Procedures

Windrowing of material at the pavement edge will not be permitted without traffic control. Care shall be taken that aggregate is not lost over the shoulder.

Measurement and Payment

This activity will be measured in miles of shoulder blading completed on each side. Payment will be made at the contract unit price. When special compaction equipment, other than truck wheel compaction, is required, it will be paid for as a negotiated item.

REBUILDING SHOULDERS WITH EARTH

FUNCTION 641

Purpose

To raise the elevation of earth shoulders, to repair washes in the shoulder and foreslope and to repair shoulder surface.

Description

Includes placing dirt on the shoulder, compacting and blading the shoulder to restore it to the elevation and width as directed by the Engineer, and seeding of the finished shoulder, foreslope and other areas disturbed within the right of way.

Quality

Each shoulder should be maintained at about 1/2 inch drop per foot of width. The shoulder width as directed by the Engineer is to be kept uniform. Material used for shoulder work shall be from a source approved by the Engineer.

Procedures

The existing shoulder will be scarified and/or bladed to remove existing vegetation and to flatten shoulder to form a base for the new fill. New fill material will be placed in accordance with Section 2123 of the Standard Specifications.

Compacted shoulder will be bladed to required width and slope. Excess material shall be carried forward and not bladed over foreslope. Seeding of the disturbed area on the shoulder and in the borrow area will be in accordance with Section 2601 of the Standard Specifications and shall be considered incidental. Wherever practical, this function will be coordinated with ditch cleaning function 655 to make best use of material removed.

Measurement and Payment

Measurement will be cubic yards placed on the shoulder. Payment will be at the contract unit price.

ROADSIDE MOWING

FUNCTION 645

Purpose

To control noxious weeds, weed patches, brush, and provide sight distance.

Description

This work shall consist of cutting vegetation with sickle, flail or rotary mowers in the rights-of-way beyond the one mower swath cut included in shoulder mowing.

Quality

Mowing shall be done in neat rectangular patches with all vegetation within the area mowed to a uniform height.

The mower cutting height shall be set such that after completion of the mowing operation the height of the remaining stubble will average six inches plus or minus one inch. More than one pass of the mowing unit may be necessary to accomplish the mowing. Bunching or windrowing the mowed vegetation will not be permitted. Where wet soil conditions result in rutting of the foreslope or backslope, mowing shall be suspended. The speed of the mowing equipment shall not exceed the ability of the mower to cut cleanly and completely.

Procedures

Mowing equipment shall consist of a tractor with a sickle type mower, an underbody rotary mower, a gang type rotary mower, or other types approved by the Engineer. Rotary mowers shall be equipped with a suction type blade and safety chains or other approved protective devices. Sickle bar mowers shall have protective shields on all sections. Broken sections shall be replaced to insure a clean, smooth cut. Different types of mowers may be used on the same project as approved by the Engineer.

Mowing in rights-of-way will be limited to cutting patches of noxious or undesirable weeds, brush and improving sight distance when directed by the Engineer.

Mowers shall not be operated on slopes steeper than 2.5 to 1.

Measurement and Payment

The length and width of areas which have been mowed shall be measured in feet and the area calculated in acres.

For the number of acres mowed, the contractor will be paid the contract unit price. This will be considered full compensation for accomplishing the mowing in accordance with the contract documents.

The contractor shall report the number of manhours utilized in the performance of this work to the Engineer at monthly intervals.

FOLIAGE SPRAYING

FUNCTION 646

Purpose

To control vegetation in pavement joints, around roadside appurtenances, and at spot locations within the roadside.

Description

This work shall consist of the application of chemicals to control vegetation, retard growth, or act as a soil sterilent.

Quality

Areas to which chemicals are applied to control noxious weeds shall kill the weeds but not result in a sterile soil condition. Where soil sterilent is used, it shall be applied such that the resultant sterile soil condition is limited to the area designated by the Engineer.

Procedures

Equipment shall be commercially available, specifically designed for the application of herbicides. Spraying equipment should be capable of applying chemicals in the correct proportions and rates in accordance with the manufacturer's recommendations.

The contractor shall maintain a daily log of spraying giving information shown on the attachment. A copy of this log shall be furnished to the Engineer. All spraying shall be done under the supervision of an applicator licensed by the State of Iowa for the application of herbicides, category 6. All chemical handling, storage, application and disposal shall conform to applicable state and federal laws.

Chemicals shall be applied to noxious weed patches and other areas identified by the Engineer at the rates specified on the label.

The contractor shall take necessary precautions to eliminate any drift which will injure adjacent vegetation. Any damage caused to adjacent property due to the application of chemicals within the right of way is the responsibility of the contractor.

The contractor should also be aware of adjacent commercial bee farms or bee hives located in the area and avoid spraying or take the necessary precautions to prevent injury.

The contractor shall report at monthly intervals the gallons of chemical solution or pounds of dry chemical applied.

Materials

Chemicals will be commercially available products, labeled for use in Iowa. The Department shall furnish the specific chemicals required. Chemicals may be in the form of a liquid or granular.

Measurement and Payment

The length and width of areas to which chemicals have been applied shall be measured in feet and the area calculated in acres.

Spot applications around posts shall be counted as 2 square feet. The length of joints treated shall be the square feet used in calculating the acres.

For the number of square feet to which chemicals have been applied, and satisfactory results obtained, the contractor shall be paid the contract unit price. This will be considered full compensation for accomplishing the work described herein.

DAILY LOG SPRAYING

- 1. DATE _____
- 2. OPERATOR'S NAME _____
- 3. EQUIPMENT "A" - "B" NUMBER ()
- 4. TEMPERATURE (_____ ° F.)
- 5. WIND--VELOCITY (_____ M.P.H.) DIRECTION ()
- 6. HIGHWAY NUMBER ()
- 7. DIRECTION OF TRAVEL ()
- 8. NAME OF HERBICIDE USED _____
- 9. AMOUNT OF HERBICIDE USED _____
- 10. TIME STARTED SPRAYING ()
- 11. TIME STOPPED SPRAYING ()
- 12. REFILLS - TIME ()
- 13. REMARKS:

14. WORK LOCATION

STA # _____ (L) (R)	STA # _____ (L) (R)
STA # _____ (L) (R)	STA # _____ (L) (R)
STA # _____ (L) (R)	STA # _____ (L) (R)
STA # _____ (L) (R)	STA # _____ (L) (R)
STA # _____ (L) (R)	STA # _____ (L) (R)
STA # _____ (L) (R)	STA # _____ (L) (R)
STA # _____ (L) (R)	STA # _____ (L) (R)

CUT BRUSH AND TREES

FUNCTION 647

Purpose

To maintain sight distance and enhance scenic beauty of the right of way.

Description

This work shall consist of the removal of undesirable brush and trees from rights-of-way, disposal of dead and diseased trees, tree trimming, and stump removal.

Quality

All trees and brush which is cut shall be in accordance with the requirements of this specification. No cut trees or brush shall be left within the right of way. Areas where stumps are removed shall be restored to the original cross-section.

Procedures

Dead trees within the right of way shall be cut and stumps 6 inches or more in diameter shall be removed. Stumps under 6 inches may be left providing the remaining height is one inch or less above the ground.

All trees, sprouts or stump growth within 30 feet of the edge of the road shall be removed, provided there is sufficient right of way. Trees beyond this limit will be permitted unless they restrict drainage, sight distance or otherwise interfere with traffic. Desirable young trees shall be thinned to approximately a 25 foot spacing.

All shrubs and brush which restrict sight distance or drainage, interfere with traffic or cause snow drifting shall be removed.

The Engineer shall identify trees and brush which are required to be removed.

All stumps which are not removed shall be treated with a chemical brush killer. Application shall be as intended for this purpose and under the general supervision of an applicator licensed by the State of Iowa. The contractor shall furnish the necessary chemical.

Trees removed within rights of way which are occupied by easement are the property of the adjacent land owner and should be offered to him before otherwise disposing. If the adjacent property owner does not want the removed trees, or a portion thereof, it shall become the property of the contractor.

All brush removed by the contractor may be chipped and spread within the highway right of way as directed by the Engineer or removed.

All trees to be disposed which are too large for chipping shall become the property of the contractor and shall be removed from the highway right of way.

No burning will be allowed within the highway right of way.

Measurement and Payment

Payment for this work will be for manhours of labor and hours of equipment used as set out in the specification for "Other Work".

LITTER PICK UP

FUNCTION 649

Purpose

To remove unsightly concentration of litter and those objects which could damage equipment and which may be projected by mowing equipment.

Description

This work shall consist of picking up litter and debris from roadsides and medians to remove unsightly concentrations of litter.

Quality

All foreign material within the roadside shall be collected and disposed including cans, bottles, boxes, containers, paper, plastic, garbage, and other items which create unsightly conditions.

Procedure

Pick up of litter shall encompass the area between right of way lines except for the shoulders and roadway surface.

Litter collected and loaded into open trucks shall be covered (tarped) when traveling on public highways.

A concentrated effort shall be undertaken each spring to thoroughly pick up all litter within the right of way. During the remainder of the year unsightly concentrations of litter shall be picked up.

The contractor shall report at monthly intervals to the Engineer the number of cubic yards of litter picked up and disposed.

All dead animals found within the roadside shall be disposed. Small animals may be buried within the right of way. Larger domestic farm animals and deer shall be removed from the right of way and disposed of in an appropriate manner consistent with State and local codes.

All litter disposal is the responsibility of the contractor and shall be completely removed from the highway. Disposal shall be consistent with State and local codes.

All fees and charges for disposing of litter, debris or dead animals shall be paid by the contractor.

Measurement and Payment

Litter pick up shall be measured in centerline miles within the limits designated by the Engineer. No additional mileage shall be added for ramps in interchange areas.

Price bid, per mile, shall be considered full compensation for two concentrated pick-ups plus incidental pick-up for the duration of the contract period.

EROSION CONTROL

FUNCTION 650

Purpose

To stop or prevent erosion within the highway right of way.

Description

This work shall consist of seeding, sodding, laying jute mesh, construction of erosion dams, and other erosion control activities.

Quality

Work shall be done in a workmanship manner and shall be appropriate to the problem to be corrected.

Procedures

The area and scope of work will be identified by the Engineer.

Work involving erosion control items shall be done in accordance with Section 2601 of the Standard Specifications as modified by the Engineer.

Seed mixtures when required will be specified by the Engineer.

Materials

Refer to Section 4169 of the Standard Specifications.

Measurement and Payment

Measurement and payment shall be as set out for "Other Work".

CLEAN AND RESTORE ROADSIDE DITCHES

FUNCTION 655

Purpose

To clean and restore ditches to adequately handle drainage and provide for snow storage.

Description

This work consists of cleaning ditches which have been choked with silt, filling of roadside ditches using dirt or rip-rap, or reshaping of roadside ditches where no material is moved to or from the work site so they will perform their intended function. Also includes cleanup of drifted silt and earth slides which do not protrude onto the shoulders or travelway.

Quality

Cleaned or restored ditches shall be finished to the specified cross-section. The area should be dressed up as directed by the Engineer to present a neat appearance and to prevent interference with mowing. All disturbed areas shall be seeded in accordance with the requirements set out in Function 650.

Procedures

The Engineer shall designate areas and limits where ditch cleaning or restoring is required.

Any staking required to establish flow lines shall be set by the Engineer.

Ditches may be wet which will preclude the operation of any equipment within the ditch limits.

Prior to any excavation it is the contractor's responsibility to notify any utility company whose facilities occupy the area to be excavated.

Material excavated shall be disposed of at the direction of the Engineer. When no disposal site exists, the contractor shall find his own disposal site off of the highway right of way. Disposal sites identified by the Engineer will be located within 2 miles of the excavation site.

Where material is required for filling, the Engineer may identify locations within the right of way where the material can be obtained within 2 miles of the fill location or the contractor will be responsible for finding his own source of fill material.

The contractor shall report to the Engineer, at monthly intervals, the lineal feet of ditch cleaned.

Material excavated may be used in conjunction with Function 641, Rebuilding Shoulders with Earth.

If working from the shoulder the operation should be set up so loaded trucks move with traffic and, if possible, the truck should turn around empty.

Measurement and Payment

The number of cubic yards of material excavated shall be calculated based on minimal cross section measurement, load count or other mutually agreed methods.

For the number of cubic yards excavated within the ditch or borrow areas, the contractor will be paid the contract unit price bid. This will be considered full compensation for accomplishing all work described herein. Any required reseeding of disturbed areas shall be paid for separately as set out in "Other Work". Seeding will be paid for separately as set out in "Other Work".

DECK REPAIR

FUNCTION 683

Purpose - to repair spalled areas on bridge decks, curbs and sidewalks.

Description

Permanent PC concrete patching of bridge decks to preserve the floor and reduce impact load. This may include curbs and sidewalks.

Quality

1. Area to be patched will be designated by the Engineer.
2. Saw the edges of the patch 3/4 to 1" deep.
3. Remove the concrete in the patch area to the top of the reinforcing steel or until sound concrete is found, whichever is deeper. No hammer heavier than 15 lb. will be allowed.
4. Clean patch area including exposed reinforcing steel with sand blast.
5. The Engineer shall be given an opportunity to inspect the patch area after cleanup and before concrete is placed.
6. Mix concrete in paddle mixer proportioning as specified in Sec. 2413.02 of the Standard Specifications, Series of 1977.
7. Just before placing concrete, apply 50-50 sand-cement grout to all surfaces of the hole. Surfaces must be dry when the grout is applied.
8. Patch should be struck off about 3/8" high and worked with a vibrating screed or vibrating plate to match adjacent surface.
9. Finish with wood trowel (particular attention to attain tight edges) and apply white pigmented curing compound immediately.
10. Open to traffic after four hour cure. All work shall be scheduled so the complete roadway is open to traffic before sundown.

Materials

Sand, gravel and cement used in deck repair shall comply with the appropriate section in the 1977 Standard Specification of the Iowa D.O.T.

Measurement and Payment

PC concrete deck patches shall be paid for at the bid price per square yard of designated area patched. Bid price shall include all labor, equipment and materials.

CLEAN DECKS, PIERS, ABUTMENTS AND EXPANSION JOINTS

FUNCTION 684

Purpose - to remove all foreign materials from bridges.

Description

Removal of foreign materials from decks, curbs and sidewalks, abutments and pier tops, cleaning drains, cleaning expansion joints, and removal of debris from trusses, beams, flanges, etc. to prevent deterioration of the structure. This activity deserves special emphasis during winter and spring when salt and treated abrasives are being used. The spring cleanup is normally scheduled as soon as weather permits.

Also includes cleaning and lubricating rollers and other devices.

Quality

Areas which have been cleaned shall be free of all accumulations of sand, gravel, dirt or other foreign materials.

Procedure

Normally, decks are cleaned using a power broom, but other methods such as water, compressed air or hand tools may be used.

Other cleaning on the bridge and lubrication of bearing devices shall be performed as directed.

Measurement and Payment

Cleaning of deck shall be paid for at the bid rate per square yard for the area designated to be cleaned. Bid price shall include all labor, equipment and materials.

Payment for other cleaning and for lubrication of bearing devices will be a negotiated item.

REPAIR BRIDGE STRUCTURE

FUNCTION 685

Purpose - to protect and/or repair the bridge, exclusive of the deck.

Description

Repair performed on bridge structures, exclusive of deck, including repair to piers, abutments, superstructure, concrete end posts, wingwalls and concrete slope protection. It may include concrete barrier curbs and deck drain extension. It also may include epoxy sealing of piers and/or abutments.

Quality

The repair shall be completed to the satisfaction of the Engineer.

Equipment and Procedure

This work shall be performed as directed by the Engineer.

Materials

Concrete used in bridge repair shall be mixed as specified in Section 2403.03 in the 1977 Standard Specification of the Iowa D.O.T.

Epoxy use for sealing piers or abutments shall be an appropriate type of penetrating epoxy and shall be one of the brands approved by the Iowa D.O.T. for this type of work.

Measurement and Payment

Measurement and payment shall be as set out for "Other Work".

BRIDGE PAINTING
FUNCTION 687

Purpose - to protect steel bridge components from rust and deterioration.

Description

Spot painting structural steel, bearing devices, handrails, and bearing pile.

Quality

The finished paint will be of uniform appearance with no sags, runs or thin areas.

Procedure

1. The area to be painted will be designated by the Engineer.
2. Remove all rust and unsound paint in the designated area by sandblasting to bare metal.
3. The Engineer shall be given the opportunity to inspect the sandblasted area before paint is applied.
4. Apply prime coat by brush or spray using a red lead paint. The application shall result in an even coat with a minimum thickness of three mils.
5. The prime coat shall be allowed to dry thoroughly.
6. Apply top coat by brush or spray using a foliage green or a white semi-gloss alkyd. This application will also result in an even coat with a minimum thickness of three mils.

Materials

All paints shall comply with Sections 4182.94, 4182.06, or 4182.07 in the 1977 Standard Specification of the Iowa D.O.T.

Measurement and Payment

Bridge painting will be paid for at the bid price per gallon of paint used on the bridge.

PRESSURE RELIEF JOINTS

FUNCTION 690

Purpose

To provide for relief of pressure in Portland Cement Concrete Pavement due to the expansion pavements at bridge and railroad crossings.

Description

Includes cutting a gap through the pavement and into the base under the pavement and out through the shoulder. Filling the trench under the pavement and through the shoulder with granular fill material and the gap in the pavement with a compressible material. Shoulders will be repaired to prior condition.

Quality

Pressure relief joints shall be cut, or recut at approaches to bridges when the existing joint has closed to 1/2 its original width.

Pressure relief joints shall be cut or recut each side of railroad crossings to prevent damage to the crossing due to pressure.

All pressure relief joints shall include drainage except when ordered otherwise by the Engineer.

Procedures

Pressure relief joints shall be installed in accord with details attached and Specification Sp-293.

Materials

Granular fill as per Supplemental Spec. No. 886. Preformed urethane foam joint material with lubricant adhesive as per Standard Road Plan RH-2 and Special Provision SP-293.

Measurement and Payment

Measurement will be for feet of joint installed and payment will be at the contract unit price.

APPENDIX C
SPECIAL PROVISIONS
FOR
MAINTENANCE ACTIVITY CONTRACT
STATE OF ARIZONA

NOTE: Conversions to equivalent metric units can be made as follows:

- 1 inch = 0.0254 meter
- 1 foot = 0.3048 meter
- 1 mile = 1.6093 kilometers
- 1 cubic yard = 0.7646 cubic meter
- 1 ton = 907 kilograms
- 1 poise = 0.1 pascal-second

648

STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS

FOR
CRACK SEALING OF BITUMINOUS PAVEMENTS

1. DESCRIPTION

The work consists of routing and cleaning cracks in the existing bituminous pavement and applying an asphalt-rubber sealant. The work does not include the patching of potholes or alligator cracks.

The work shall be accomplished in accordance with the requirements of these special provisions.

2. LOCATION OF WORK

The sealing of cracks may be required on any portion of any highway under the jurisdiction of the State. Each maintenance section is identified by a BLC number, the geographical location of which is shown on the map which is included in the proposed pamphlet.

3. ANTICIPATED REQUIREMENTS

It is anticipated that approximately 300,000 pounds of asphalt-rubber sealant will be required throughout the State and that the minimum amount to be placed at any one location will be approximately 5,000 pounds.

4. BIDDING REQUIREMENTS

Bids are solicited for furnishing and applying sealant material and for providing for traffic control at each of the BLC's as indicated on the Bidding Schedule. Unit prices shall include the

costs of all materials, equipment, tools, labor, taxes, etc., and shall represent the total cost to the Department.

In order to compare bids, the unit price bid per pound for the sealant material will be multiplied by 6,520 and the unit price bid per hour for traffic control will be multiplied by 15.

5. AWARD OF CONTRACT

An award of contract, if made, will be made to the bidder submitting the lowest total bid.

6. DURATION OF CONTRACT

The contract will be for a period of twelve months from the date of the complete execution of the contract.

7. SCHEDULE

The work shall be performed as required and as scheduled by the Engineer. The Engineer will furnish the specific location of work by route number and milepost and will furnish the approximate quantity of material required for each location.

8. MATERIAL

8.1 General

The sealant to be used shall be any one of the following:

- (a) A mixture of asphalt and vulcanized, granulated rubber
- (b) A mixture of asphalt, extender oil, and reclaimed (devulcanized) and ground vulcanized rubber
- (c) Premixed block material consisting of asphalt and 100% vulcanized rubber
- (d) Premixed block material consisting of asphalt and 60% vulcanized and 40% devulcanized rubber.

All materials shall meet the requirements of these special provisions and the Contractor shall furnish a certification that the material meets the requirements. The certificate shall be signed by a party legally able to bind the supplier and his signature shall be notarized.

All materials shall be free of fabric, wire or other contaminating materials. No more than 4 percent by calcium carbonate may be included to prevent the particles from sticking together.

The gradation of the material will be determined by sieves which meet the requirements of AASHTO M92. The gradation and the specific gravity shall meet the following requirements:

Sieve Size	Percent Passing		Premixed	Premixed
	Asphalt-Rubber (Vulcanized)	Asphalt-Rubber (Devulcanized)	Asphalt-Rubber (100% Vulcanized)	Asphalt-Rubber (60% Vul.-40%De
No. 8	100	100	100	100
No. 10	98-100		98-100	
No. 30		60-80		60-80
No. 40	0-10		0-10	
No. 50		15-40		15-40
No. 100		0-15		0-15
Specific Gravity	1.15+ 0.2	1.25+ 0.2	1.15+ 0.2	1.25+ 0.2

8.2 Asphalt

Asphalt shall be Grade AC-10 and shall conform to the requirements of Table 705-1 which is included in these special provisions.

Asphalt shall be fully compatible with the ground rubber used to produce the asphalt-rubber material.

8.3 Extender Oil

The extender oil shall be a resinous, aromatic hydrocarbon meeting the following requirements when tested as indicated:

Test	ASTM Test Method	Requirement
Viscosity, SSU, at 100 degrees F.	D88	2,500, Min.
Flash Point, COC Open Cup	D92	392, Min.
Molecular Analysis	D2007	
Asphaltenes, % by wt.		0.1 Max.
Aromatics, % by wt.		55 Min.

8.4 Devulcanized Rubber

Ground rubber shall be a dry, free flowing blend of 40+ 2% powdered, reclaimed (devulcanized) rubber and 60+ 2% vulcanized rubber scrap which has a natural rubber content of at least 30 percent.

The natural rubber content will be determined in accordance with the requirement of ASTM D297.

In order to determine that the required percentage of reclaimed (devulcanized) rubber is present in the blend, 40 to 50 grams of the rubber which is retained on the No. 30 sieve will be added to a tight set, 6-inch rubber mill roll. If the required percentage is present, the material will band on the mill roll in one pass.

9. MIXING REQUIREMENTS

9.1 General

The methods utilized to combine the materials and the design of the equipment shall be such that the Engineer can readily determine the percentages by weight of the materials being incorporated into the mixture.

9.2 Asphalt-Rubber (Vulcanized)

The mixture shall consist by weight of 75 ± 2 percent asphalt and 25 ± 2 percent rubber.

The materials shall be combined as rapidly as possible for such a time and as such a temperature that the consistency of the mixture approaches that of a semi-fluid material. Since the time required to achieve this state is a function of the temperature of the asphalt, the time may vary from a minimum of 10 minutes at 450 degrees F. to as much as 60 minutes at 350 degrees F.

9.3 Asphalt-Rubber (Devulcanized)

The mixture shall be a combination of asphalt, extender oil, and rubber. The amount of rubber to be used shall be 25 ± 2 percent of the total weight of the mixture.

The asphalt shall be heated to between 250 and 400 degrees F. and combined with from 2 to 6 percent of the extender oil based on the weight of the asphalt. The viscosity of the mixture of asphalt and extender oil shall be between 600 and 1,800 poises at 140 degrees F. when tested in accordance with the requirements of AASHTO T 202. The mixture shall be thoroughly mixed by recirculation, stirring, air agitation, or by other means.

The temperature of the mixture of asphalt and extender oil shall be increased to from 350 to 425 degrees F. and the rubber shall then be added as rapidly as possible. The mixture shall be circulated, or stirred, for not less than 30 minutes after all the rubber has been added so that all the materials are thoroughly dispersed. Sufficient heat shall be applied so that the temperature of the mixture is between 350 and 425 degrees F.

9.4 Premixed Block Material

The block material shall be a premixed, prepacked, uniform and homogeneous mixture of asphalt and rubber. The mixture shall consist by weight of 75 ± 2 percent asphalt and 25 ± 2 percent rubber.

10. EQUIPMENT

The equipment used in the application of the asphalt-rubber material shall have a mixing system in the heating unit in order to maintain a consistent, uniform, homogeneous mixture throughout the crack sealing operation. The equipment shall be designed so as to provide a continuous supply so that operations may proceed without delays.

11. CONSTRUCTION

11.1 Weather

The asphalt-rubber mixture shall not be placed during wet weather or under other conditions which will adversely affect the operations. The sealant shall not be placed in cracks which are wet.

If weather conditions are such as to affect adversely the operations, the Engineer will determine whether or not the operations should cease. He shall be the sole judge.

11.2 Routing and Cleaning of Cracks - Applying Sealant

All cracks to be sealed shall be cleaned to a depth of from 5/8 inch to 7/8 inch.

All cracks, which have an average clear opening of less than 1/2 inch, shall be routed. All cracks which have an average clear opening of 1/2 inch or greater may be designated for routing. The Engineer shall be the sole judge of the cracks that shall be routed.

The router shall be centered as nearly as practicable over the crack. The router shall have a bit that is wide enough to cover the size of the crack being routed. Several passes may be necessary to route the cracks. Immediately prior to applying the sealant, the cracks shall be thoroughly cleaned of all loose particles, dust and other deleterious substances by means of high velocity, compressed air or by any other methods approved by the Engineer.

The sealant shall be applied so that the finished surface of the sealant is from 1/16 inch to 1/8 inch below the surface of the pavement. The sealant shall be placed entirely within the crack and no lapping of cracks will be allowed.

After the work has been completed, the site shall be left clean and free of excess material, debris, etc.

12. TRAFFIC CONTROL

All traffic shall be maintained throughout the work area in accordance with the requirements of the Department's Traffic

Control Manual. If there is any condition which requires special traffic control or signing, the resolution shall be discussed with the Engineer and agreed to by him.

All signs, flagmen and other traffic control devices and all equipment necessary for the control of traffic shall be furnished by the Contractor.

The work shall be performed on weekdays, excluding officially designated State holidays.

The work shall normally be performed during the daylight hours; however, if traffic conditions warrant it, the Engineer may extend the time in which the work may be accomplished.

13. MEASUREMENT

13.1 Sealant

Measurement for materials applied in any one location will be limited to the materials applied. Quantities of material remaining in the heating unit after the completion of the work at any location will not be measured for payment.

The sealant will be measured by the pound and will include the asphalt and any extender oil. Measurement of premixed block material or ground rubber may be based on either the number and weight of the carton or boxes, or by weighing devices furnished by the Contractor. The Engineer may order that any packaged material be reweighed.

13.2 Traffic Control

Traffic control will be measured by the hour. Measurement will include no more than 1/2 hour before the start of work and no more than 1/2 hour after the work has been completed for the setting up and removal of signs. The number of hours at any location will be to the nearest hour.

14. BASIS OF PAYMENT

The accepted quantities of sealant will be paid for at the contract price per pound of sealant. The accepted quantities of traffic control will be paid for at the contract price per hour.

Payment will be made as follows:

Pay Item	Pay Unit
Sealant	Pound
Traffic control	Hour

15. EXPECTED RESULTS

It is expected that a crack sealed in accordance with the requirements of these special provisions will last at least four years.

A crack failure is indicated when there is a loss of bond between the sealant and the vertical face of the crack; when the sealant is fractured; and when there is a loss of sealant, any or all conditions as a result of normal traffic.

The failure of cracks shall not exceed the following:

End of Year	Percent Failure at Any Location
1	0
2	4
3	6
4	10

16. GUARANTEE

Failures at any location at any time after the end of the first year through the period at the end of the fourth year in excess of the percentages shown shall be remedied to the satisfaction of the Engineer in the manner as indicated herein or by other means satisfactory to the Engineer.

The Engineer shall be the sole judge as to the cracks that have failed and as to the methods and materials used to remedy the failures.

BIDDING SCHEDULE

Premixed Block Material or Ground Rubber (Including Asphalt or Extender Oil) Per Pound	BLC	Traffic Control Per Hour
\$		\$
	C210	
	C211	
	C212	
	C213	
	C214	
	C215	
	C216	
	C219	
	C220	
	C221	
	C222	
	C223	
	C224	
	C225	
	C226	
	C230	
	C231	
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	C254	
	C255	
	C260	
	C261	
	C262	
	C263	
	C264	
	C265	
	C270	
	C271	
	C272	
	C273	
	C274	
	C275	
	C276	
	C279	
Total of Unit Prices \$	C-12	Total of Unit Prices = \$
Total X 6,520 = \$		Total X 15 = \$
		GRAND TOTAL = \$

STATUTORY PAYMENT BOND PURSUANT TO TITLE 34,
CHAPTER 2, ARTICLE 2 OF THE ARIZONA REVISED STATUTES
(PENALTY OF THIS BOND MUST BE 100% OF THE CONTRACT AMOUNT)

KNOW ALL MEN BY THESE PRESENTS:

That, _____,
(hereinafter called the Principal), As Principal, and _____
_____, a corporation
organized and existing under the laws of the State of _____,
with its principal office in the city of _____,
(hereinafter called the Surety), as Surety, are held and firmly bound unto the Arizona Department of Transportation (here-
inafter called the Obligee) in the amount of _____
_____ dollars (\$ _____), for
the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, successors
and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____
day of _____, 19____, to construct and complete a certain work described as _____

which contract is hereby referred to and made a part hereof as fully and to the same extent as-if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall promptly
pay all monies due to all persons supplying labor or materials to him or his subcontractors in the prosecution of the work
provided for in said contract, then this obligation shall be void, otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that this bond having been required of the said Principal in order to comply with the
provisions of Title 34, Chapter 2, Article 2, of the Arizona Revised Statutes, all rights and remedies on this bond shall
inure solely to such persons and shall be determined in accordance with the provisions, conditions, and limitations
of said Title, Chapter and Article, to the same extent as if they were copied at length herein.

The prevailing party in a suit on this bond shall recover as a part of his judgment such reasonable attorneys'
fees as may be fixed by a judge of the Court.

Witness our hands this _____ day of _____, 19 _____.

PRINCIPAL SEAL BY:

SURETY SEAL BY:

AGENCY OF RECORD AGENCY ADDRESS

STATUTORY PERFORMANCE BOND PURSUANT TO TITLE 34,
CHAPTER 2, ARTICLE 2 OF THE ARIZONA REVISED STATUTES
(PENALTY OF THIS BOND MUST BE 100% OF THE CONTRACT AMOUNT)

KNOW ALL MEN BY THESE PRESENTS:

That, _____,
(hereinafter called the Principal), as Principal, and _____
_____, a corporation
organized and existing under the laws of the State of _____,
with its principal office in the City of _____,
(hereinafter called the Surety), as Surety, are held and firmly bound unto the Arizona Department of Transportation
(hereinafter called the Obligee) in the amount of _____
_____ dollars (\$ _____), for

the payment whereof, the said Principal and Surety bind themselves, and their heirs, administrators, executors, suc-
cessors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____
day of _____, 19____, to construct and complete a certain work described as _____

_____ which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the said Principal shall faith-
fully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the
original term of said contract and any extension thereof, with or without notice to the Surety, and during the life of any
guaranty required under the contract, and shall also perform and fulfill all the undertakings, covenants, terms, conditions,
and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which
modifications to the Surety being hereby waived; then the above obligation shall be void, otherwise to remain in full
force and effect;

PROVIDED, HOWEVER, that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2,
of the Arizona Revised Statutes, and all liabilities on this bond shall be determined in accordance with the provisions
of said Title, Chapter and Article, to the extent as if it was copied at length herein.

The prevailing party in a suit on this bond shall recover as a part of his judgment such reasonable attorneys'
fees as may be fixed by a judge of the Court.

Witness our hands this _____ day of _____, 19_____.

PRINCIPAL SEAL BY: _____

SURETY SEAL BY: _____

AGENCY OF RECORD AGENCY ADDRESS

CERTIFICATE OF INSURANCE

In accordance with the requirements of Subsection 107.16 - Insurance in the special provisions, this will certify that the individual, company or corporation shown below has the insurance herein described in full force and effect.

All insurance policies or certificates shall include an endorsement providing for 30 days prior written notice to the Arizona Department of Transportation of any cancellation or reduction of coverage.

LIMITS OF LIABILITY

General Liability - Bodily Injury and Property Damage Combined*

Each Occurrence

\$1,000,000.00

Automobile Liability - Bodily Injury and Property Damage Combined*

Each Occurrence

\$1,000,000.00

*If both General and Automobile Liability covered by the same "Umbrella" Policy, \$1,000,000 Combined Single Limit is acceptable.

CONTRACTOR

PROJECT NUMBER(S)

BY

TERMINI

DATE

June, 1969
Revised August, 1969
Revised July, 1974
Revised August, 1981

1. COMPREHENSIVE GENERAL LIABILITY AND AUTOMOBILE LIABILITY INCLUDING CONTRACTORS PUBLIC LIABILITY:

Policy Number(s): _____
Expiration Date: _____
Insurer: _____
Agency of Record: _____
Agency Address: _____
By: _____

2. EXCESS COMPREHENSIVE GENERAL LIABILITY AND AUTOMOBILE LIABILITY INCLUDING CONTRACTORS PUBLIC LIABILITY:

Policy Number(s) _____
Expiration Date: _____
Insurer: _____
Agency of Record: _____
Agency Address: _____
By: _____

3. UMBRELLA LIABILITY (COMMERCIAL):

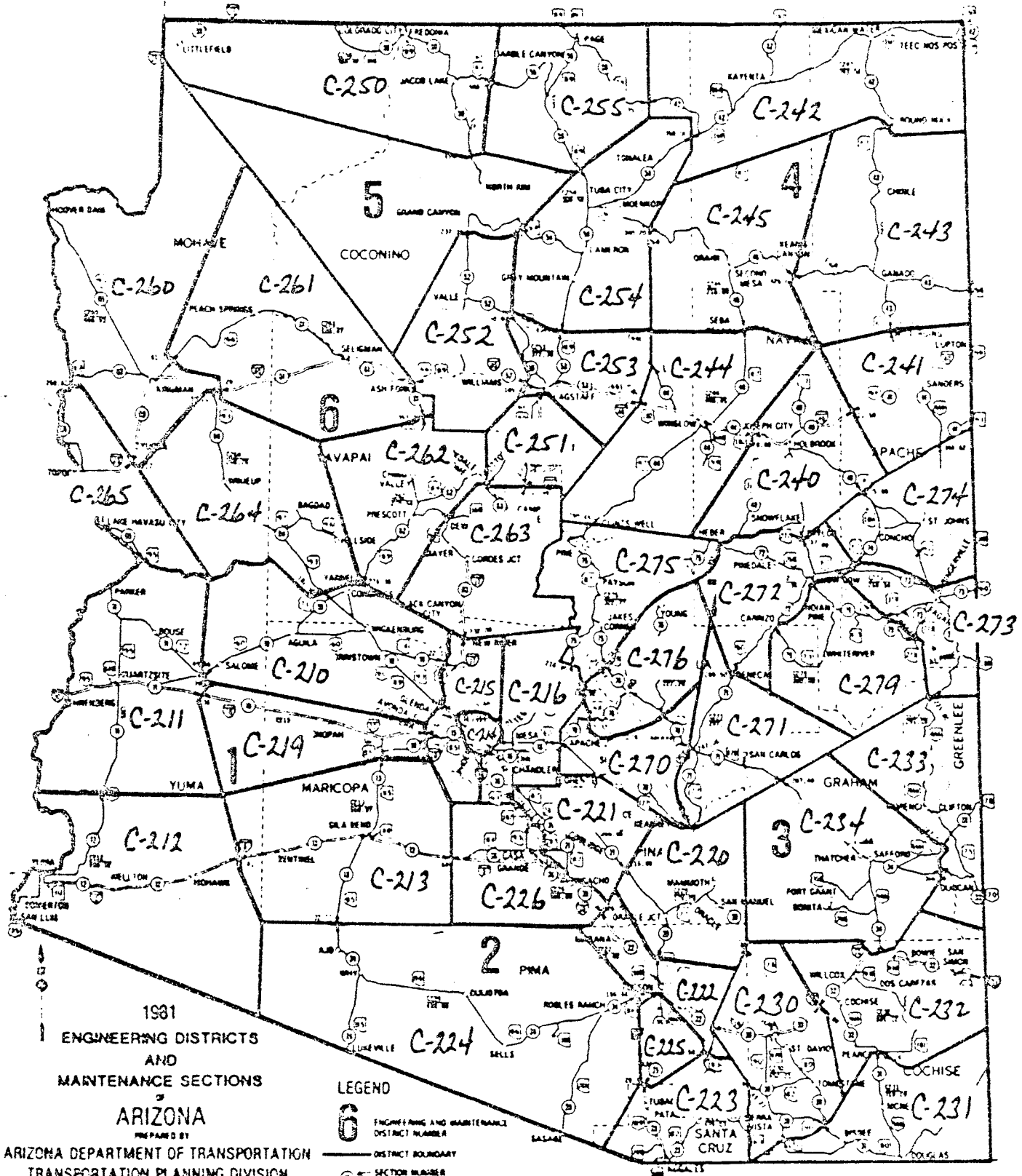
Policy Number(s): _____
Expiration Date: _____
Insurer: _____
Agency of Record: _____
Agency Address: _____
By: _____



With respect to the acts of _____, officers, employees, subcontractors, and/or agents, in the performance of work on the project, the State of Arizona, acting by and through the Arizona Department of Transportation, shall be named as an additional insured on the above policy(ies).

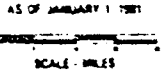


With respect to the acts of _____, its officers, employees, subcontractors, and/or agents, operating upon or within the rights-of-way of the Salt River Valley Water Users' Association (Association) and the Salt River Project Agricultural Improvement and Power District (District), the Association and the District shall be named as an additional insured on the above policy(ies).



1981
 ENGINEERING DISTRICTS
 AND
 MAINTENANCE SECTIONS
 OF
 ARIZONA
 PREPARED BY
 ARIZONA DEPARTMENT OF TRANSPORTATION
 TRANSPORTATION PLANNING DIVISION

- LEGEND
- ENGINEERING AND MAINTENANCE DISTRICT NUMBER
 - DISTRICT BOUNDARY
 - SECTION NUMBER
 - SECTION TERM
 - MILE POST NUMBER
 - APPROVED ALIGNMENT



STATE OF ARIZONA
 DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
FULL-WIDTH LITTER PICKUP

1. DESCRIPTION

The work shall consist of the picking up of litter (paper, plastics, bottles, cans, boards, tires, etc.) along the full-width of right-of-way.

The work shall be accomplished in accordance with the requirements of these special provisions.

2. LOCATION OF WORK

U.S. Route 60: MP 31 (Jct. I-10 at OP) to MP 149 (west city limits, Peoria)

MP 188 (east city limits, Mesa) to MP 224
 (west city limits, Superior)

MP 227 (east city limits, Superior) to
 MP 243 (west city limits, Miami)

MP 245 (east city limits, Miami) to MP 248
 (west city limits, Globe)

State Route 87: MP 178 (Jct. McDowell Road) to

MP 251 (south city limits, Payson)

3. ANTICIPATED REQUIREMENTS

The anticipated annual requirement at the listed locations is approximately 245 right-of-way miles of litter pickup.

4. BIDDING REQUIREMENTS

Bid is solicited for picking up litter at listed locations. Unit price shall include the cost of litter bags, equipment, tools, labor, taxes, etc., and shall represent the total cost to the Department.

In order to compare bids, the unit price bid per right-of-way mile will be multiplied by 245.

5. AWARD OF CONTRACT

An award of contract, if made, will be made to the bidder submitting the lowest total bid.

6. DURATION OF CONTRACT

The contract will be for a period of twelve months from the date of the complete execution of the contract.

7. SCHEDULE

The work shall be performed as required and as scheduled by the Engineer. The Engineer will furnish the specific location of work by route and milepost.

Except as may be otherwise approved in writing by the Engineer, the work shall be accomplished during the weekdays, except for official State holidays.

If weather inimical to the work operation occurs, the Engineer may order that litter pickup stop. Work shall not be resumed until ordered by the Engineer.

8. LITTER PICKUP REQUIREMENTS

It is anticipated that litter pickup will be accomplished by manual labor; it is not intended to be restrictive or to limit any work techniques which will improve work quality or productivity.

The width to be worked shall be: from edge of roadway to R/W fence; from edge of roadway across the median to edge of roadway. For a one mile length of a two-way route, two right-of-way miles exists.

Example: (Edge of roadway to R/W fence times 2)

For one mile of interstate route this would be 4 right-of-way miles.

Example: (Edge of roadway to R/W fence times 2 plus edge of roadway to centerline of median times 2)

All accumulated litter in bags, as well as objects such as boards, tires, rocks, etc. shall be deposited at locations designated by the Engineer for eventual pickup by State forces.

9. TRAFFIC SAFETY

All traffic shall be maintained throughout the work area in accordance with the requirements of the Department's Traffic Control Manual for Construction and Maintenance. If there is any condition which requires special traffic control or signing, the resolution shall be discussed with the Engineer and agreed to by him.

All signs, flagmen and other traffic control devices and all equipment necessary for the control of traffic shall be furnished by the Contractor.

The work shall normally be performed during the daylight hours; however, if traffic conditions warrant it, the Engineer may extend the time in which the work may be accomplished.

10. MEASUREMENT

All measurement of litter pickup will be measured by right-of-way miles.

11. BASIS OF PAYMENT

The accepted quantities of right-of-way miles as provided above, will be paid for at the contract unit price and shall constitute full compensation for litter pickup.

Payment will be made under:

<u>Pay Item</u>	<u>Payment</u>
Litter pickup	Right-of-way mile

BIDDING SCHEDULE
FOR
LITTER PICKUP

Right-of-Way Miles		Unit Price	Total Cost
245	X	\$ _____	\$ _____

STATE OF ARIZONA
 DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
SWATH MACHINE MOWING

1. DESCRIPTION

The work shall consist of cutting weeds, grass and other mowable vegetation within a five feet width area measured from the edges of the roadway and mowable right-of-way.

The work shall be accomplished in accordance with the requirements of these special provisions.

2. LOCATION OF WORK

U.S. Route 60: MP 31 (Jct. I-10 at OP) to MP 149 (west city limits, Peoria)

MP 188 (east city limits, Mesa) to MP 224 (west city limits, Superior)

MP 227 (east city limits, Superior) to MP 243 (west city limits, Miami)

MP 245 (east city limits, Miami) to MP 248 (west city limits, Globe)

State Route 87: MP 178 (Jct. McDowell Rd.) to MP 251 (south city limit of Payson)

3. ANTICIPATED REQUIREMENTS

The anticipated annual requirement at the listed locations is approximately 600 swath miles minimum to 1,200 swath miles maximum.

4. BIDDING REQUIREMENTS

Bids are solicited for cutting weeds and grass and other mowable vegetation at listed locations. Unit prices shall include the costs of all materials, equipment, tools, labor, taxes, etc., and shall represent the total cost to the Department.

In order to compare bids, the unit price bid per swath mile will be multiplied by 900.

5. AWARD OF CONTRACT

An award of contract, if made, will be made to the bidder submitting the lowest total bid.

6. DURATION OF CONTRACT

The contract will be for a period of twelve months from the date of the complete execution of the contract.

7. SCHEDULE

The work shall be performed as required and as scheduled by the Engineer. The Engineer will furnish the specific location of work by route number and milepost.

Except as may be otherwise approved in writing by the Engineer, the work shall be accomplished during the weekdays, except for official State holidays.

If weather inimical to the work operation occurs, the Engineer may order the mowing stopped. Work shall not be resumed until ordered by the Engineer.

8. MOWING REQUIREMENTS

It is anticipated that mowing will be accomplished by medium to large sized (5' to 8' cutting widths) commercial machine mowers; it is not intended to be restrictive or to limit any work techniques which will improve work quality or productivity.

The width to be mowed shall be a minimum of five feet measured from the roadway edge and mowable right-of-way.

Additional swaths may be necessary for safe sighting distances and pullout safety.

9. TRAFFIC SAFETY

All traffic shall be maintained throughout the work area in accordance with the requirements of the Department's Traffic Control Manual for Construction and Maintenance. If there is any condition which requires special traffic control or signing, the resolution shall be discussed with the Engineer and agreed to by him.

All signs, flagmen and other traffic control devices and all equipment necessary for the control of traffic shall be furnished by the Contractor.

Mowers shall be equipped with a flashing beacon light.

The work shall normally be performed during the daylight hours; however, if traffic conditions warrant it, the Engineer may extend the time in which the work may be accomplished.

10. MEASUREMENT

All measurement of mowing will be measured by the swath mile.

11. BASIS OF PAYMENT

The accepted quantities of swath miles as provided above, will be paid for at the contract unit price and shall constitute full compensation for mowing.

Payment will be made under:

<u>Pay Item</u>	<u>Payment</u>
Mowing	Swath mile

12. EXPECTED RESULTS

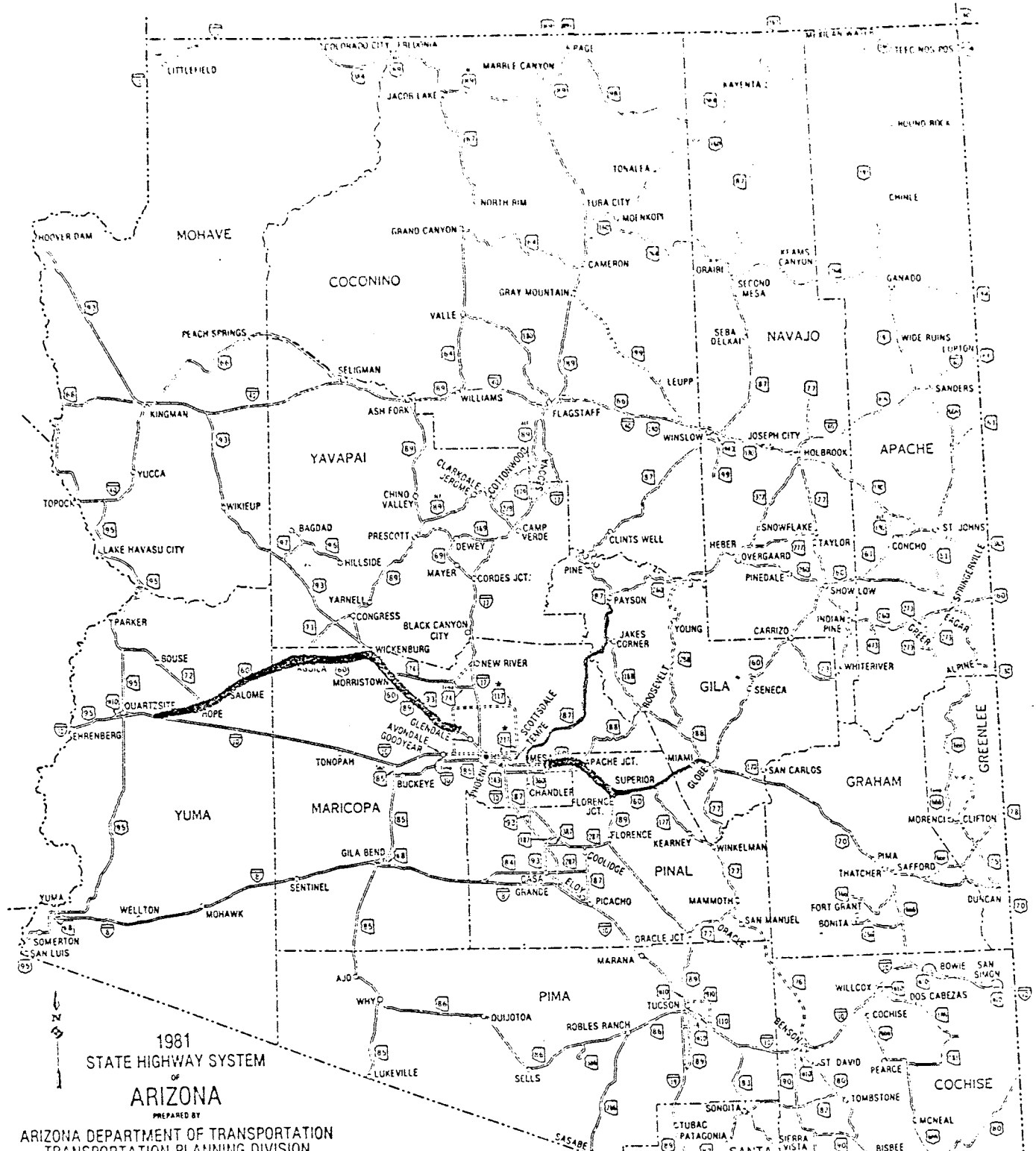
When cutting in a horizontal plane, vegetation cut height shall not be shorter than 5" nor taller than 7" measured from ground.

Cuttings left on roadway shall be removed.

BIDDING SCHEDULE

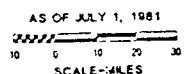
FOR
MOWING

Swath Miles		Unit Price	Total Cost
900	X	\$ _____	\$ _____



1981
STATE HIGHWAY SYSTEM
of
ARIZONA

PREPARED BY
ARIZONA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING DIVISION



- LEGEND
- STATE HIGHWAYS
 - - - SURVEY ONLY (APPROX. ALIGNMENT)
 - * NUMBERS TEMPORARILY ASSIGNED

Sections of roadway
to be let to contract

STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
ASPHALT PATCHING WITH PREMIX

1. DESCRIPTION

Asphalt patching consists of repairs to potholes, severe depressions and leveling of irregular pavement surfaces with a hot or cold bituminous premix material.

The work shall be accomplished in accordance with the requirements of these special provisions

2. LOCATION OF WORK

U. S. Route 60: MP 31 (Jct. 1-10 at OP) to MP 149 (west city limits, Peoria)

MP 188 (east city limit, Mesa) to MP 224 (west city limits, Superior)

MP 227 (east city limit, Superior) to MP 243
(west city limits, Miami)

MP 245 (east city limits, Miami) to MP 248
(west city limits, Globe)

State Route 87: MP 178 (Jct. McDowell Rd.) to MP 251 (south city limit of Payson)

3. ANTICIPATED REQUIREMENTS

The anticipated annual requirement at the listed locations is approximately 500 tons (262 cubic yards) of premix in place.

4. BIDDING REQUIREMENTS

Bids are solicited for furnishing and applying hot or cold bituminous premix material and for providing for traffic control at each of the BLC's as indicated on the Bid Schedule. Unit prices shall include the costs of all materials, equipment, tools, labor, taxes, etc., and shall represent the total cost to the Department.

In order to compare bids, the unit price bid per ton for the premix material will be multiplied by 50.

5. AWARD OF CONTRACT

An award of contract, if made, will be made to the bidder submitting the lowest total bid.

6. DURATION OF CONTRACT

The contract will be for a period of twelve months from the date of the complete execution of the contract.

7. SCHEDULE

The work shall be performed as required and as scheduled by the Engineer. The Engineer will furnish the specific location of work by route number and milepost and will furnish the approximate quantity of material required for each location.

8. MATERIAL

8.1 Premixed Asphalt Concrete

Asphaltic concrete for patching shall be produced from commercial sources or any sources approved by the Engineer.

All materials shall meet the requirements of these special provisions and the Contractor shall furnish a certification that the material meets the requirements. The certificate shall be signed by a party legally able to bind the supplier and his signature shall be notarized.

8.1a Materials

Aggregate for asphaltic concrete shall have an abrasion of not more than nine percent loss at 100 revolutions when tested in accordance with AASHTO-T-96. The aggregate shall be crushed and processed to the following grading limits such that the sand equivalent is at least 45 when tested in accordance to AASHTO T-176. The gradation will be determined in accordance with Arizona Test Method 201.

Grading Limits

Sieve Size	Percent Passing
3/4 inch	100
1/4 inch	55-75
No. 8	40-55
No. 200	0-6.0

8.1b Asphalt Cement

The bituminous material shall conform to the requirements of Section 705 of the Standard Specifications for AC-20, AC-30 or AC-40 asphalt cement. The exact grade to be specified by the Engineer prior to use.

8.1c Proportions

The asphalt cement content shall be approximately 5.0 percent, by weight, of the total mixture. However, the exact percentage shall be specified by the Engineer.

8.2 Control of Material

Only materials conforming to the requirements of the Specifications and approved by the Engineer shall be used in the work. The Contractor shall furnish certification that material used meets specifications.

8.2a Testing

The Engineer reserves the right to sample and test the material and mixture as he deems necessary to determine that it reasonably conforms to the requirements specified herein.

8.3 Unused Material

Material remaining, which was not utilized in the work will not be billed as work accomplished, nor billed as a part of this contract. Unused material will be determined by the Engineer.

9. CONSTRUCTION

9.1 Weather

The mixture shall not be placed during wet weather or under other conditions which will adversely effect the operations. The mixture shall not be placed in potholes which are wet.

If weather conditions are such as to affect adversely the operations, the Engineer will determine whether or not the operations should cease. He shall be the sole judge.

9.2 Procedures

The minimum procedures shall be used when accomplishing the various activities of asphalt patching.

Potholes

Procedures:

- a. Establish traffic control (safety devices, signs, etc.).
 - b. Square up and straighten edges.
 - c. Insure area to be repaired is clean, dry and free of any loose or broken material.
 - d. Apply tack coat to vertical sides and bottom.
 - e. Deposit premix and compact in two inch lifts maximum.
(Compact each layer with hand tamper or truck wheel.)
 - f. Check the finished surface with straight edge.
 - g. Broom loose, excess material; clean up.
- Badly distorted rutted areas, severe depressions.

Procedures:

- a. Establish traffic controls (safety devices, signs, etc.)
- b. Mark approximate limits of area to be leveled.
- c. Sweep surface area if required with power or hand broom.
- d. Apply tack coat.
- e. Spot dump premix from truck.
- f. Spread premix, make sure the surface is level and feather the edges smoothly with exposed existing pavement.
- g. Broom loose, excess material; clean up.

Alligator Cracking

Procedures:

- a. Establish traffic control (safety devices, signs, etc.)
- b. Remove surface material within marked limits leaving sides vertical.

- c. Inspect base for dryness and for adequate support. If base replacement is required, notify Engineer or his designee for his approval.
- d. Apply tack coat.
- e. Place mix in maximum two inch lifts and compact.
- f. Broom loose, excess material; clean up.

Edge Breakup

Procedures:

- a. Establish traffic control (safety devices, signs, etc.)
- b. Remove surface material within marked limits leaving sides vertical.
- c. Inspect base for dryness.
- d. Apply tack coat in accordance to instruction from Engineer or designee.
- e. Place mix in maximum two inch lifts and compact.
- f. Broom loose, excess material; clean up.

10. TRAFFIC CONTROL

All traffic shall be maintained throughout the work area in accordance with the requirements of the Department's Traffic Control Manual. If there is any condition which requires special traffic control or signing, the resolution shall be discussed with the Engineer and agreed to by him.

All signs, flagmen and other traffic control devices and all equipment necessary for the control of traffic shall be furnished by the Contractor.

The work shall be performed on weekdays, excluding officially designated State holidays.

The work shall normally be performed during the daylight hours; however, if traffic conditions warrant it, the Engineer may extend the time in which the work may be accomplished.

11. MEASUREMENT

All asphaltic premixed material will be measured by the ton of material in place based upon certified material used and recorded by the Engineer, or by measuring and weighing devices furnished by the Contractor.

The Department reserves the right to have any material re-weighed and weight tickets verified at the convenience of the Department.

12. BASIS OF PAYMENT

The accepted quantities of asphaltic premix material, as provided above, will be paid for at the contract unit price and shall constitute full compensation for the bituminous mixture complete in place.

Payment will be made under:

<u>Pay Item</u>	<u>Payment</u>
Premix	Ton

13. EXPECTED RESULTS

Patched area shall be shaped reasonably square or rectangular.

Patched area shall be left clean and free of any excess material.

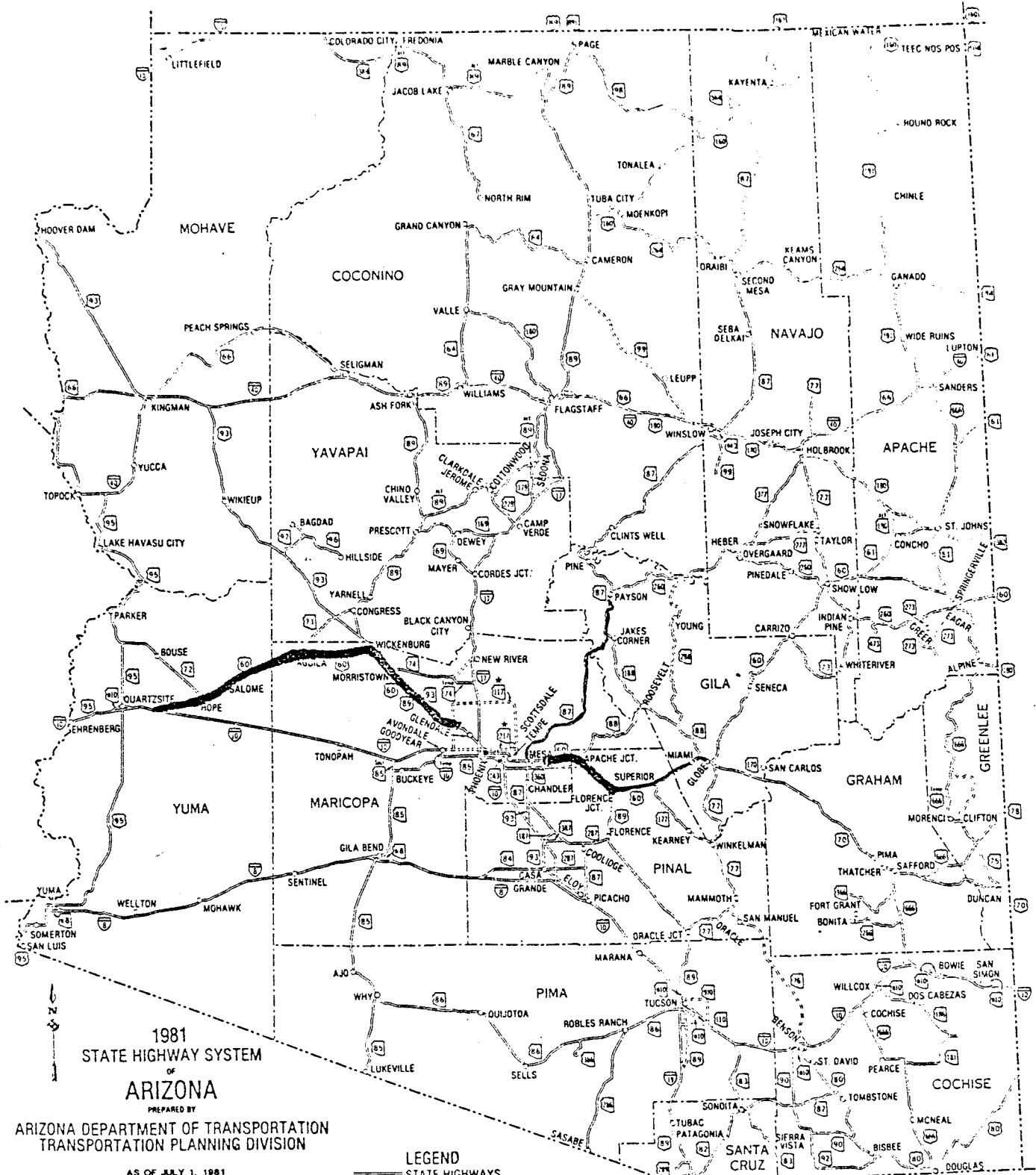
Patch shall not present a bump or depression and shall provide a reasonably smooth ride and transition for at least six months.

A failure is indicated when there is a loss of bond between the patch and the vertical face of the pavement; when the patch is fractured; and when there is a loss of patch material; any or all conditions as a result of normal traffic.

14. GUARANTEE

Failures at any location at any time after the end of six months shall be remedied to the satisfaction of the Engineer in the manner as indicated herein or by other means satisfactory to the Engineer.

The Engineer shall be the sole judge as to the patched areas that have failed and as to the methods and materials used to remedy the failures.



1981
STATE HIGHWAY SYSTEM
OF
ARIZONA

PREPARED BY
ARIZONA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING DIVISION

AS OF JULY 1, 1981
SCALE - MILES

LEGEND
 — STATE HIGHWAYS
 - - - SURVEY ONLY (APPROX. ALIGNMENT)
 * NUMBERS TEMPORARILY ASSIGNED

*Sections of roadway
to be let to contract*

STATE OF ARIZONA
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISIONS
FOR
URBAN AREA CURB SWEEPING

1. DESCRIPTION OF WORK:

The work shall consist of the sweeping of debris accumulated on the roadway along the curbs, median walls, in turnout areas at intersections and major interchanges and along the curbs of bridges. The work shall also include the picking up of objects that cannot be swept up, such as boards, tires, rocks, etc.

2. LOCATION OF WORK:

The location of the proposed work is on Interstate Route 10, Interstate Route 17 and State Route 360 as specifically described as follows:

2.1 Interstate Route 10

The eastbound and westbound roadway between milepost 148.56 and milepost 153.57 is approximately 20.72 curb miles.

The westbound frontage road between milepost 153.10 and milepost 153.57 is approximately 0.74 curb miles.

The eastbound and westbound on and off ramps between milepost 148.56 and milepost 153.57 is approximately 6.23 curb miles.

The overhead structures at 48th Street and at Broadway Road from right-of-way to right-of-way is approximately 0.80 curb miles.

2.2 Interstate Route 17

The northbound and southbound roadway between milepost 194.02 and milepost 208.30 is approximately 57.12 curb miles.

The northbound and southbound frontage road as follows:

Milepost to Milepost	
Northbound	Southbound
197.94 - 199.06	197.94 - 199.24
	199.69 - 199.82
	201.11 - 201.67
212.67 - 213.21	212.67 - 213.23

The length of the frontage road is approximately 4.21 curb miles.

The northbound and southbound on and off ramps between milepost 194.02 and 213.20 is approximately 28.80 curb miles.

2.3 State Route 360

The two curbs on the eastbound and westbound roadway between milepost 0.00 and milepost 0.51 is approximately 1.02 curb miles.

The right curb only on the eastbound and westbound roadway between milepost 0.51 and milepost 10.46 is approximately 19.90 curb miles.

The eastbound and westbound on and off ramps between milepost 0.00 and milepost 10.46 is approximately 16.72 curb miles.

The prospective bidders shall satisfy themselves as to the amount of sweeping to be accomplished on the main roadways, the frontage roads, the ramps and the crossroads.

Prospective bidders are urged to contact either Joseph Guerrini or Al Scott at the Arizona Department of Transportation, District 1 Headquarters, 2140 West Hilton Avenue, Phoenix, Arizona; phone (602)261-7381 to arrange for a tour of the work locations.

3. SWEEPING REQUIREMENTS

It is anticipated that the accumulated debris will be removed by sweeping; however, other methods, such as by means of a vacuum, may be used if the results produced meet or exceed those obtained by sweeping.

The width to be swept shall be at least five feet. One pass of the sweeper for a distance of one mile will be deemed to be one curb mile.

Approximately 153.30 curb miles shall be swept 26 times in the twelve-month period following the execution of the contract.

4. WORK SCHEDULE

Except as may be otherwise approved in writing by the Engineer, the work shall be accomplished during the weekdays, except for official State holidays, between the following hours:

9:00 A. M. to 3:30 P. M.

8:30 P. M. to 5:00 A. M.

If weather inimical to the sweeping operation occurs, the Engineer may order that the sweeping stop. Sweeping shall not be resumed until ordered by the Engineer.

5. TRAFFIC CONTROL:

Traffic flow around the sweeper shall be maintained. All sweeping shall be accomplished "with" the traffic flow instead of opposing traffic. All traffic control measures shall be in accordance with the requirements of the Arizona Department of Transportation Traffic Control Manual for Highway Construction and Maintenance.

A flashing arrow board shall be furnished. Arrow boards shall conform to the requirements of Section 6E-7 and 6E-9 of the Traffic Control Manual, and as specified herein. Arrow boards shall be truck mounted, trailer mounted, or shall be mounted on the sweeper. Type C, 48" x 96", shall be used. Either the arrow display or the chevron display shall be furnished; however, after July 1, 1982, all arrow boards shall be of the chevron display type.

Each sealed beam lamp shall provide a minimum of 7,000 candlepower, and shall cast a yellow light. Lights shall have a beam spread 40 degrees horizontal and five degrees vertical. Each lamp shall be hooded. Each chevron stripe or arrowhead shall be formed with a minimum of five lamps.

The arrow board shall be equipped with an automatic and a manual light intensity dimmer which is capable of a minimum 50 percent dimming from the rated lamp voltage.

Each arrow board shall have its own independent power source consisting of either a gasoline or a diesel unit with a minimum of six horsepower. The power source shall be capable of supplying adequate continuous power for the sign operation over extended periods of time. Fuel capacity shall be such as to provide for at least 12 hours of continuous operation without refueling.

6. Dump Sites

All accumulated debris, as well as objects such as boards, tires, rocks, etc., shall be hauled to a dump site and deposited. If material is not deposited at one of the following sites, the contractor shall furnish the Engineer with evidence from the property owner and from either the City of Phoenix or Maricopa County that he has been given permission to dump material at the location chosen by the Contractor:

- (1) Near the intersection of 40th Street and Interstate Route 10 adjacent to the westbound roadway.
- (2) On the corner of 23rd Avenue and Durango, next to the District 1 Maintenance Yard.
- (3) North of Indian School Road adjacent to the southbound frontage road.
- (4) North of Glendale Avenue adjacent to the northbound frontage road.
- (5) Between the islands in the southwest clover leaf ramps at the Bell Road Traffic Interchange.

7. DUST CONTROL

During the sweeping operation, water shall be used in order to reduce the dust. The Contractor shall make all arrangements for obtaining the water required.

8. METHOD OF MEASUREMENT

The work will be measured by the number of curb miles swept for a width of at least five feet and cleaned and free of all accumulated debris and foreign objects.

9. BASIS OF PAYMENT

The accepted quantities of curb miles swept will be paid for at the contract price per curb mile, complete as herein described and specified.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Curb Sweeping in Urban Areas	Curb Mile

