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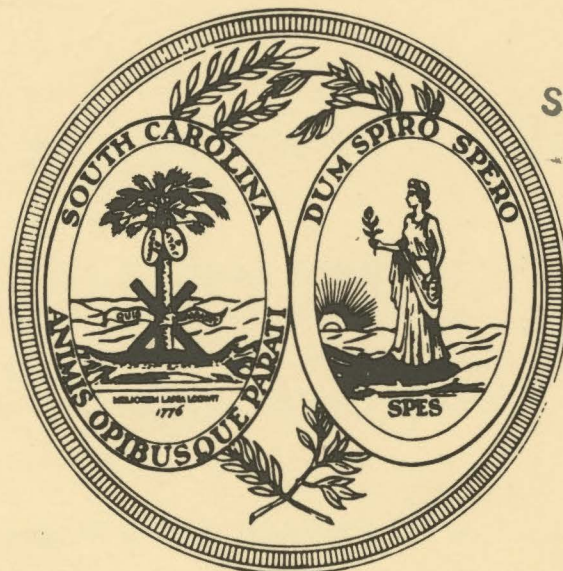
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Legislative Audit Council



The State of South Carolina
General Assembly
Legislative Audit Council
A Review of Road-Paving
Costs in South Carolina
April 16, 1981

THE STATE OF SOUTH CAROLINA

GENERAL ASSEMBLY

LEGISLATIVE AUDIT COUNCIL

A REVIEW OF ROAD-PAVING COSTS

IN

SOUTH CAROLINA

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INTRODUCTION

In May 1980, the South Carolina House of Representatives requested the Legislative Audit Council (LAC) to investigate the rising cost of road paving. Concurrent Resolution H.3288 directed the Council to review relevant factors involved in road construction in the State (see Appendix A).

Chapter I covers the Council's summary of findings pertaining to the management of road construction programs by the South Carolina Department of Highways and Public Transportation (SCDHPT). Chapter II presents LAC's investigation of road construction costs for State funded primary and secondary roads, and resurfacing projects. Chapter III explains the Council's findings in depth.

During its examination of road paving costs, the Council cooperated with the United States Justice Department in its investigation of alleged bid rigging on South Carolina highway construction projects. Because of the ongoing investigation by the Justice Department, any influence that bid rigging may have on the cost of road construction falls outside the scope of this audit. The Council appreciates the cooperation and assistance given by SCDHPT and its staff. LAC also thanks the various Federal, State and local officials and private individuals who assisted the Council in developing this report.

CHAPTER I
REPORT SUMMARY

Introduction

From its study of road paving programs, LAC could find no method or material that will significantly lower the cost of constructing roads. Instead, the Council found that the Highway Department's major problem is the decline of motor fuel tax revenue during a period of rising paving and maintenance costs. In the past, increasing motor fuel tax revenue and stable costs permitted the Highway Department to build and maintain the State highway system.

Currently, all needs of the State's highway system cannot be fulfilled with revenue generated under the existing funding structure. Road construction and maintenance are financed through the State's Motor Fuel Tax and tax from this source is based on the number of gallons of fuel sold. Tax collections are not tied to rising costs so that as fewer gallons of fuel are sold less revenue is collected. As an example, the State Tax Commission found that 164,917,699 or 10% fewer gallons of gasoline were used in 1980 than 1978. A legislative committee is studying methods of financing for the Department which will address this revenue problem.

The Highway Department cannot continue to provide the same level of services as in the past. Although the Council could find no method or material that will lower costs, there are certain measures that can be taken to derive maximum benefit from scarce tax dollars. Currently, 5,727 miles (or 15%) of the State's 39,294 miles of road need resurfacing but the Highway Department continues to build new roads. A redistribution of resources should be weighed against the building of new roads.

The Department needs to direct more of its resources to resurfacing roads which have reached the end of their useful life and developing a modern maintenance system for the large scale upkeep needed on the State's roads in the 1980's.

Chapter III of this report reviews various aspects of the South Carolina Department of Highways and Public Transportation's administrative and management practices. The following summary provides an overview of the problem areas noted, while further details and recommendations for improvement are contained at the end of this section and throughout the body of the report. These findings are measures that SCDHPT can use to reduce costs and more effectively use the State's Motor Fuel Tax.

SCDHPT is Unable to Maintain the State's Highways

The South Carolina Department of Highways and Public Transportation (SCDHPT) is constructing and accepting more roads into the State's highway system than it can properly maintain. While more roads are accepted into the system each year, fewer miles are resurfaced and many are reaching the end of their designed pavement life.

As of July 1980, the Highway Department estimates that 5,727 miles or 15% of the State's road system needs to be resurfaced. These roads have reached the point in their design life where ordinary maintenance can no longer restore pavement life and resurfacing is needed to prevent deterioration.

South Carolina Codes, Sections 57-11-40 and 57-11-50 establish priorities for the expenditures of the State Motor Fuel Tax by the Highway Department during a fiscal year. Section 57-11-50 states that

after the Department pays for the retirement of its bonds and operating expenses it will appropriate,

...a sum sufficient to maintain the highways of the State highway system for such year in a sound and serviceable condition. [Emphasis Added]

Without an adequate resurfacing program, the State's maintenance program is in jeopardy of being overwhelmed by the large scale repairs needed on the State's highways in the 1980's. When a road's pavement reaches the end of its design life, it must be resurfaced or total pavement failure quickly occurs. As more roads reach this point, pothole patching or other routine maintenance activities can no longer prevent pavement failure and the State's investment in its roads is lost (see p. 50).

Need to Implement a Maintenance Management System

The South Carolina Department of Highways and Public Transportation has no systematic method of setting statewide road maintenance priorities. Instead, the Department has to rely primarily on its district and field maintenance engineers to determine the roads to be repaired. No effort is made to collect data to establish objective criteria for determining which repairs are most needed in the State highway system. During the next five fiscal years (FY 80-81 to FY 84-85) the Department estimates that maintenance will grow from \$64 million or 22% of its budget, to a total of \$95.5 million or 50% of its anticipated \$192.4 million total budget in FY 84-85.

The Department is facing this increased maintenance responsibility without the benefit of a maintenance management system for determining the priority repair needs of the State's entire road network. South Carolina is the only State of the ten southeastern states which does not

have such a system. In the 1980's, with revenue declining, the Department will need a more objective, systematic approach to allocating scarce resources to protect the State's \$2.6 billion investment in its highways (see p. 57).

Weight Enforcement Program is Inadequate

The South Carolina Department of Highways and Public Transportation has not provided enough weight enforcement personnel to adequately enforce truck weight laws. The State has the lowest number of weight enforcement personnel, the highest number of miles per weight enforcement person, and the second lowest amount of fines collected of the ten southeastern states (see p. 61). In addition, South Carolina's fine structure is not as strict as North Carolina, Georgia and Florida, which makes the State's fine system less of a deterrent to overweight trucks.

It is important that the State have an adequate weight enforcement program because the impact of a heavy truck is disproportionately greater than the weight carried. A 5-axle, 80,000-pound tractor trailer has the impact of 9,600 automobiles, although it weighs about the same as 20 automobiles.

With the small number of personnel in the weight enforcement division, it is difficult to enforce weight laws effectively nor can present weight facilities be adequately utilized. There are nine permanent weigh stations, and only two of these are operated each week for an average of 35 hours. If roads are not manned more effectively and fines increased to deter weight limit violators, highways will deteriorate at an accelerated rate. Ensuring that weight limits are obeyed will

prevent additional maintenance and reconstruction costs to South Carolina highways (see p. 59).

Providing Access Driveways to Private Property

The State Highway Department is installing and paving private driveways free of charge to property owners from the shoulder of the road to the right-of-way line. In the Fiscal Years 1977-78 to 1979-80, the Department spent \$13.6 million installing and paving driveways. This is an average of \$4.5 million a year, \$2.1 million for paving and \$2.4 million for culvert pipe and installation.

In its sample of resurfacing contracts, the Council found that it costs an average of \$20,384 per mile in 1980 to resurface a road in South Carolina (see p. 24). If the Department spent the yearly average of \$4.5 million it spends on driveways for resurfacing, 222 additional miles of road could be resurfaced, a 45% increase over the projected resurfacing program for FY 80-81 (see p. 67).

Equipment Maintenance Program is Inefficient

The Highway Department has an inefficient equipment maintenance program. The Department spends considerable time and money repairing an aging maintenance fleet. The Audit Council found that the Department's downtime for equipment averages 19.5%. Downtime is the amount of time equipment is inoperative and awaiting repairs. A downtime rate of 19.5% means that one out of every five working days is used for repairing maintenance equipment. A 50-state study conducted in July 1978 by New York State found that downtime rates higher than 15% should be avoided.

Equipment breakdowns and unavailability decrease the efficiency with which highway maintenance plans are executed and result in higher costs. Delays, and the need to reschedule maintenance work that results from equipment breakdown, mean less than full utilization of maintenance manpower (see p. 68).

Roads and Drives of State Facilities Funded by Highway Department

The South Carolina Department of Highways and Transportation is constructing and maintaining roads and driveways for State parks and State institutions at no cost to the State facility. The projects are funded by the State Highway Department. From FY 77-78 to FY 79-80, the Department spent \$978,991 constructing and maintaining streets, roads, and driveways for State facilities. No state in the nine southeastern states the Council surveyed constructs or maintains all the roads and driveways of state facilities free of charge.

Since the construction and maintenance of roads and drives for State parks and institutions are funded by the State Highway Department, the actual cost of operation for these State facilities are not reflected in their budget. The cost is incurred in the State highway budget, resulting in understating the cost of State parks and institutions.

This method requires State agencies to justify paving needs only to the Highway Department. These requests are thus placed outside of the normal budgeting process and State agencies are not required to justify and set priorities for their capital improvements to the House and Senate appropriation committees and the General Assembly (see p. 75).

RECOMMENDATIONS

1. THE GENERAL ASSEMBLY SHOULD CONSIDER ADOPTING A JOINT RESOLUTION REDIRECTING THE PRIORITIES FOR EXPENDITURES OF FUNDS UNDER SOUTH CAROLINA CODES, SECTION 12-27-400. THIS RESOLUTION SHOULD CONSIDER ADOPTING ONE OR MORE OF THE FOLLOWING OPTIONS IN ORDER TO REDUCE THE STATE'S RESURFACING INVENTORY AND TO ESTABLISH AN ADEQUATE RESURFACING PROGRAM FOR THE STATE'S HIGHWAYS.

A. A MORATORIUM ON C-FUNDED SECONDARY ROAD CONSTRUCTION SHOULD BE CONSIDERED. THIS MORATORIUM SHOULD BE FOR A PERIOD OF TIME SUFFICIENT TO ALLOW THE HIGHWAY DEPARTMENT TO SUBSTANTIALLY REDUCE ITS RESURFACING BACKLOG.

B. ONCE THIS BACKLOG IS REDUCED THE DEPARTMENT SHOULD ESTABLISH CRITERIA FOR SETTING ASIDE AN AMOUNT OF THE "FARM TO MARKET" ROAD REVENUE TO FUND AN ADEQUATE RESURFACING PROGRAM.

C. IF A MORATORIUM IS NOT CONSIDERED THE GENERAL ASSEMBLY SHOULD DIRECT THE DEPARTMENT TO REDIRECT ITS SPENDING PRIORITIES ON THE STATE SECONDARY ROAD PROGRAMS FROM NEW CONSTRUCTION TO RESURFACING BASED ON A PERCENTAGE OF THE FUNDS NEEDED TO ADEQUATELY REDUCE THE BACKLOG OF ROADS THAT NEED RESURFACING.

2. THE HIGHWAY DEPARTMENT IN ACCORDANCE WITH SOUTH CAROLINA CODES, SECTIONS 57-5-40 AND 57-11-50 SHOULD DECIDE WHICH ROADS WILL BE RESURFACED AND IN COOPERATION WITH LOCAL COUNTY GOVERNMENTS, DECIDE WHICH ROADS WILL BE CONSTRUCTED AND ACCEPTED INTO THE STATE HIGHWAY SYSTEM.
3. THE HIGHWAY DEPARTMENT SHOULD ESTABLISH A MAINTENANCE MANAGEMENT SYSTEM. THE SYSTEM SHOULD HAVE OBJECTIVE CRITERIA FOR SETTING REPAIR PRIORITIES AND MAKING DECISIONS ON MAINTENANCE ACTIVITIES FOR THE ENTIRE STATE HIGHWAY NETWORK.

4. THE HIGHWAY DEPARTMENT SHOULD CAREFULLY STUDY ITS STAFFING NEEDS IN ORDER TO ENSURE TRUCK WEIGHT LAWS ARE ADEQUATELY ENFORCED ON STATE HIGHWAYS.
5. CIVIL PENALTY FINES SHOULD BE INCREASED TO ADEQUATELY DETER WEIGHT LIMIT VIOLATORS.
6. THE DEPARTMENT SHOULD DISCONTINUE ITS PROGRAM OF PAVING DRIVEWAYS TO THE RIGHT-OF-WAY LINE AND PROVIDING FREE LABOR AND PIPE FOR DRIVEWAY INSTALLATION.

DRIVEWAY INSTALLATION SHOULD BE THE RESPONSIBILITY OF THE PROPERTY OWNER AND THE DEPARTMENT SHOULD EXERCISE ONLY PLAN APPROVAL, PERMIT ISSUANCE AND INSPECTION AUTHORITY ACCORDING TO SOUTH CAROLINA CODES, SECTION 57-5-1080 AND 57-5-1090. THOSE DRIVEWAYS FAILING TO MEET THE STANDARDS ESTABLISHED BY THE DEPARTMENT SHOULD BE CLOSED IN ACCORDANCE WITH SOUTH CAROLINA CODES, SECTION 57-5-1110.

ONCE THE DRIVEWAY HAS BEEN BUILT TO STANDARDS, INSPECTED AND ACCEPTED BY THE DEPARTMENT, IT SHOULD BE THE DEPARTMENT'S RESPONSIBILITY TO MAINTAIN THE DRIVEWAY TO THE RIGHT-OF-WAY LINE. THE DEPARTMENT SHOULD PAVE A "STUB OUT" FROM THE SHOULDER OF THE ROAD TO THE ENTRANCE OF THE DRIVEWAY ONLY. SHOULD CONDITIONS ON THE ROAD CHANGE SO AS TO REQUIRE THE RELOCATION OR REMOVAL OF THE DRIVEWAY, IT SHOULD BE THE DEPARTMENT'S RESPONSIBILITY TO INSTALL A NEW ACCESS FOR THE PROPERTY OWNER.

7. THE DEPARTMENT SHOULD IMPLEMENT AN EQUIPMENT MANAGEMENT SYSTEM, A SYSTEM GEARED TOWARDS OBTAINING MAXIMUM PRODUCTIVITY FROM EQUIPMENT AND EQUIPMENT SUPPORTING RESOURCES. THIS WOULD ESTABLISH A SYSTEMATIC APPROACH FOR EQUIPMENT BUDGETING AND REPLACEMENT.

8. THE DEPARTMENT SHOULD FORM A TASK FORCE TO STUDY THE TOTAL COST BIDDING TECHNIQUE FOR PURCHASING EQUIPMENT AND AS A METHOD TO REDUCE REPAIR COSTS.

9. THE DEPARTMENT SHOULD DISCONTINUE ITS PROGRAM OF CONSTRUCTING AND MAINTAINING ROADS AND DRIVEWAYS FOR STATE PARKS AND INSTITUTIONS FREE OF CHARGE.

PARKS OR INSTITUTIONS SHOULD BE RESPONSIBLE FOR THE CONSTRUCTION AND MAINTENANCE OF THEIR ROADS AND DRIVES UNLESS THE ROADS ARE INCLUDED IN THE STATE HIGHWAY SYSTEM.

PARKS OR INSTITUTIONS SHOULD PRESENT THEIR REQUEST AND JUSTIFICATION FOR ROAD CONSTRUCTION AND MAINTENANCE AS PART OF THEIR ANNUAL BUDGET REQUESTS.

CHAPTER II

FACTORS AFFECTING THE COST OF ROAD CONSTRUCTION

Introduction

During the 1980 Session of the South Carolina General Assembly, the House of Representatives requested the Legislative Audit Council (LAC) "to investigate the rapidly increasing cost of road paving..." Concurrent Resolution H.3288 directed the Council to examine the bidding process, materials used and other relevant factors involved in road paving contracts. In addition, the Council was requested to look at road paving practices to determine if alternative methods could be used to reduce road paving costs (see Appendix A).

To determine how much road paving costs have increased, the Council first examined 522 bid estimates and the actual costs on 479 projects of road construction and resurfacing contracts let in odd years from 1970 to 1980. LAC then randomly selected a sample of road construction and resurfacing contracts to identify what items within road paving projects have increased in cost. The Council also examined the costs of materials and equipment used by paving contractors on road projects. Last, road paving technology and practices were researched by the Council to determine if alternative methods or materials are available to lower the costs of road paving.

This section of LAC's report will cover the State's bidding process to include bidding procedures, contract distribution, department estimates and bid rigging. Also included in this section are the Council's conclusions on road paving costs, the cost to contractors of materials and equipment used in road construction and resurfacing projects, and what

alternative method or practices are available to perhaps lower costs of road paving.

Bidding Process

Bidding Procedures

The South Carolina Department of Highways and Public Transportation (SCDHPT) has established rules and regulations for the prequalification of all contractors who bid on Highway Department projects. These rules and regulations are set forth in South Carolina Codes, Section 57-5-1650 and have been in effect since January 1, 1960. No bids are accepted from persons, firms or corporations that have not been prequalified by the Department.

Under these regulations a contractor is given a rating based on a verified showing of experience, net liquid assets, responsibility record and available equipment. Contractors must show net liquid assets at least equal to 15% of the capacity rating assigned by the Department. The Department updates its ratings on individual contractors every two years by requiring new financial statements from them. If necessary ratings are changed based on the information supplied and contractors who do not renew their qualification records are barred from bidding on future projects.

South Carolina Code, Section 57-5-1620 requires the Department to advertise its contracts in one or more daily newspapers in the State. In recent years, due to the rising cost of advertising, the Department has advertised only in the Columbia newspapers. However, SCDHPT has a policy of mailing notices of upcoming projects, three weeks prior

to bid openings, to all contractors who are qualified, in accordance with South Carolina Code, Section 57-5-1650, to bid on projects currently advertised.

Section 57-5-1620 also requires the Department to award its contracts to the lowest, qualified bidder. The law states:

Awards of contracts, if made, shall be made in each case to the lowest qualified bidder whose bid shall have been formally submitted in accordance with requirements of the Department.

Bid lettings are held on the Tuesday preceding the third Thursday of each month. Bidders are required to submit proposals on the form furnished by the Department. Prices must be stated in figures for each item of work and bidders may not offer counterproposals linking a bid on one project with a bid on another project unless a counterproposal is authorized in the special provisions in the proposal. Bidders are not allowed to file with their bids any letters limiting the number of projects on which they will accept an award. Bidders are awarded all projects on which their low bids are satisfactory to the Department, provided they are qualified for such projects.

The State Highway Commission meets on the third Thursday of each month. Bids are reviewed by the State Highway Engineer who makes his recommendations to the Chief Highway Commissioner. The Chief Highway Commissioner makes his recommendations to the Commission which then approves or disapproves the recommendations. Letters awarding the contracts are signed by the Chief Highway Commissioner.

The Department reserves the right to reject any or all proposals or counterproposals, to waive technicalities or to advertise for new proposals, if in the judgement of the Chief Highway Commissioner, the best interest of the Department will be served. If only one bid is received

the Department will accept it and will award the contract, provided it does not exceed 10% of the Department's estimate. Awards for Federal-aid projects are made only after concurrence by the Federal Highway Administration (FHWA), except for projects administered under the Secondary Road Plan.

Low bids which exceed the engineer's estimates may or may not be rejected, depending on the priority of the projects and the percentages of the amounts over the engineer's estimates. Bids which are rejected by the Department are done on the belief that lower bids will be received on readvertisement.

Bidders are not required to submit bid deposits but a bid bond must be submitted by each bidder in the amount of 5% of the bidder's total bid price. The bond assures that the bidder will execute the contract if he is the low bidder. Bid bonds submitted by other than the successful low bidder are routinely destroyed when the contract is awarded. The Department returns them to the bidders only when requested by the bidders. Within 20 days after the date of award, the successful bidder must execute the contract and file with the State Highway Department a Performance and Indemnity Bond covering 100% of the contract amount and a Payment Bond covering 50% of the contract amount.

Contract Distribution

As part of its investigation, the Council tested the distribution of contracts among qualified firms. The Council noted the names of firms awarded contracts for 616 road paving projects over a ten-year period. The LAC found that these 616 contracts were awarded to 128 firms and

that the firms which received the largest number of contracts in any one year changed from year to year. From the data examined, the Council could find no evidence of any one firm or group of firms monopolizing contract awards.

To test the awards process more thoroughly, the Council picked a sample of 96 highway construction contracts to determine how many contractors were bidding on individual projects. An analysis of the 96 highway construction contracts found that a total of 411 contractors bid on the projects, an average of 4.3 bidders per project. Analysis also showed that 74 or 77% of the projects had three or more bidders. In all cases the lowest bidder was accepted. The following is a breakdown of the number of bidders per project.

											Totals
No. of Bidders Per Project	1	2	3	4	5	6	7	8	9	10	
No. of Projects	9	13	19	17	10	11	7	7	0	3	96
Percentage of Total	9%	14%	20%	18%	10%	12%	7%	7%	0%	3%	100%

Department Estimates

To determine how well the Highway Department has estimated its road construction costs, the Council compared the Department's estimates with the bid prices received on 84 sample contracts used in the bidders' test. These 84 contracts were composed of 45 State Secondary (C-funds) and 39 State Primary (A-Funds) road projects let from 1970 to 1980. Total bid proposals on 45 Secondary road projects exceeded the Department's estimate by only 2.0% and the bid proposals on 39 State primary roads by only 1.4%. The following table shows the difference between the Department's estimate and the bids received on the 84 projects.

TABLE 1
BIDS AND HIGHWAY DEPARTMENT ESTIMATES ON
STATE SECONDARY AND PRIMARY ROAD PROJECTS

<u>Project</u>	<u>Number of Contracts</u>	<u>Total Low Bids Received</u>	<u>Total Highway Department Estimate</u>	<u>Dollar Difference</u>	<u>Percentage Difference</u>
Secondary	45	\$12,127,589	\$11,884,050	\$243,539	2.0
Primary	39	\$29,900,482	\$29,491,730	\$408,752	1.4

Bid Rigging

As part of its audit tests of bidders and bid estimates, the Council attempted to detect if bid rigging is occurring on the Highway Department's road contracts. Representatives of the Justice Department and the Federal Bureau of Investigation (FBI) in Columbia, South Carolina told the Council that the audit process cannot find bid rigging. LAC was told that no technique or method can be applied in auditing to detect bid rigging because this crime is a conspiracy that can only be uncovered through testimony.

In August 1980, the United States Justice Department began investigating contractors for bid rigging on road contracts in South Carolina. In November 1980, one North Carolina company pleaded guilty in Federal Court in Columbia, South Carolina and was fined \$150,000. The Justice Department told the Council that this conviction was a part of an ongoing investigation of bid rigging on road contracts in South Carolina and several southeastern states.

Road Paving Costs

This section is divided into two parts. One will deal with the statistical information kept by the State Highway Department and the Federal Highway Administration (FHWA). The second part will develop the data collected by the Council on road construction and resurfacing contracts in the Highway Department.

Highway Cost Statistics

When the Council began its audit of road paving costs, a problem developed concerning sources of statistical information on road paving projects. The Council found that although the FHWA collects a large amount of data on highway construction, the compiled statistical information was of no help in determining how much South Carolina actually pays to build a road or how these costs compare to other states.

More importantly, research conducted by the South Carolina Pavement Association and confirmed by FHWA, found that the 1979 prices for a ton of asphalt in Georgia, North Carolina, and South Carolina quoted by FHWA in its "Annual Price Trends for Federal-Aid Highway Construction," were inaccurate. In a letter dated November 12, 1980 to the Columbia, South Carolina Office of FHWA, the Pavement Association concluded that the errors found led the Association to, "...believe that a weakness sufficient to compromise the accuracy of FHWA's annual report does exist." The Association found that South Carolina received lower prices for asphalt than Georgia and North Carolina.

Other problems existed which hampered LAC in its efforts to determine actual road construction costs in South Carolina and led to the Council's decision to abandon the FHWA statistics and develop its own data base. First, the FHWA collects data only on Federal-aid

projects which are \$500,000 or larger. Second, the cost categories reported by FHWA do not have uniform standards for reporting individual cost items. Therefore, what one state may report as the cost of a category may contain more individual items than the same category reported by another state. The lack of uniformity creates the illusion of one state appearing to get good prices on a category such as "pavements," when actually it is reporting fewer items under that category than other states. Last, the cost categories used by FHWA only cover 60% of the total expense items contained in a road construction project so that the total cost of building a road is not presented.

Within the Highway Department, the Council found that no one division or individual is responsible for compiling accumulative information on the actual costs of road paving projects. The Department monitors each contract to ensure accuracy of payment but does not collect data on actual costs of road paving for reporting purposes. The Department does collect and report statistical information on bid estimates for the FHWA and its own use.

Road construction contracts contain many expense items. In order to identify what items are increasing the cost of paving roads, the Council requested the Deputy State Highway Engineer to segregate these items into distinct and separate categories. State primary roads were divided into seven categories, the State secondary roads into five, and resurfacing projects were segregated according to the types of asphalt used, plus an "other" category was designated to cover all miscellaneous items (see Tables 5-7 for a breakdown of the categories).

Contract Costs

Two different methods can be used to review the cost of paving roads. One is to analyze the bid estimates for a particular time period while the other is to determine the cost of contracts completed during that time. The Audit Council did both. LAC first examined 522 bid estimates on road construction and resurfacing contracts let in odd years from 1970 to 1980. The Council then examined the final, actual costs of 479 contracts completed in the same period of time. These estimates and contracts were funded solely by State funds, no federally-funded projects were used. They were segregated by type of project and Highway Department funding code: State Primary Road - A Funds, State Secondary Road - C Funds, and State Funded resurfacing projects - no special fund code. Since road projects are completed a year or more after they are let and costs are rising, the actual contract cost figures lagged behind the bid estimate cost figures as shown in Tables 2 and 3.

Road construction costs are rising primarily for two reasons. The inflationary trend of road building is higher than the Consumer Price Index (see p. 40). Also, the types of road under construction today are short, urban streets which have more stringent design standards and tend to be more costly (see p. 22).

The Council's examination of C-funded Secondary Road projects found that bid estimates increased by 98.2% between 1977 and 1979 (see Table 2). This increase to pave a mile of secondary road is not totally supported by a corresponding increase to contractors in cost of road paving materials and equipment. However, in recent years roads built in the State's C-fund, "farm to market" program have changed. The

rural, secondary "farm to market" program once paved long stretches of rural county roads. These roads required little design engineering and the long stretches allowed a contractor to concentrate his crew and machinery in one area to lay a lot of bituminous pavement more economically.

In the latter part of the 1970's, an increasing number of C-fund roads were built in subdivision, urban and small town areas. These roads tend to be short segments and the urban nature of the streets demand more pipes for drainage, culverts, catch basins, seeding and even sidewalks. The short segments do not permit a contractor to concentrate his workforce and machinery in one area, thus eliminating the economy of scale found in long stretches of road. The increased need for pipes, catch basins, culverts, etc., not found on older, rural secondary roads, also increases the cost of C-funded roads.

Cost figures for State Primary roads show fluctuations over the period examined by the Council. These variances in cost are due to the type of primary road and its location. In the later years, more stringent design standards and the building of primary roads in urban areas cause the average cost per mile to vary greatly. Resurfacing projects however, demonstrate a smooth increase over a period of time since this type of project is primarily the laying of asphalt. Tables 2 and 3 show the increase in bid estimates and actual costs for C-funded State secondary, A-funded State primary and resurfacing road contracts from 1971 to 1980.

TABLE 2
PROJECT BID ESTIMATES FOR C-FUNDED SECONDARY,
A-FUNDED PRIMARY AND RESURFACING ROAD CONTRACTS

C-Funded Secondary Road Contracts

<u>Year</u>	<u>Number of Bids</u>	<u>Project Bid Estimates</u>		<u>Cost Per Mile</u>
		<u>Total Cost of Bids</u>	<u>Total Mileage</u>	
1971	13	\$ 3,019,012	83.553	\$ 36,133
1973	27	\$ 8,006,251	185.188	\$ 43,233
1975	48	\$10,784,310	234.422	\$ 46,004
1977	62	\$10,826,551	232.372	\$ 46,591
1979	53	\$20,012,967	216.752	\$ 92,331
1980	39	\$13,959,084	150.563	\$ 92,713

Percent Increase 1971 to 1980: 157%.

A-Funded Primary Road Contracts

<u>Year</u>	<u>Number of Bids</u>	<u>Project Bid Estimates</u>		<u>Cost Per Mile</u>
		<u>Total Cost of Bids</u>	<u>Total Mileage</u>	
1971	33	\$27,006,954	349.903	\$ 77,184
1973	35	\$29,392,506	186.494	\$157,606
1975	2	\$ 516,491	1.032	\$500,476
1977	7	\$ 2,109,763	8.675	\$243,200
1979	7	\$ 8,596,873	12.419	\$692,236
1980	No Projects Let.			

Percent Increase 1971 to 1979: 797%.

TABLE 2 (CONTINUED)

Resurfacing Contracts

<u>Year</u>	<u>Number of Bids</u>	<u>Project Bid Estimates</u>		
		<u>Total Cost of Bids</u>	<u>Total Mileage</u>	<u>Cost Per Mile</u>
1971	29	\$ 7,080,547	778.49	\$ 9,095
1973	26	\$ 7,733,904	716.207	\$ 10,798
1975	15	\$ 4,251,788	366.47	\$ 11,602
1977	38	\$ 7,711,910	655.786	\$ 11,760
1979	52	\$14,059,827	799.079	\$ 17,595
1980	36	\$11,473,223	562.845	\$ 20,384

Percent Increase 1971 to 1979: 124%.

TABLE 3
ACTUAL PROJECT COSTS FOR C-FUNDED SECONDARY,
A-FUNDED PRIMARY AND RESURFACING ROAD CONTRACTS

C-Funded Secondary Road Contracts

<u>Year</u>	<u>Number of Projects</u>	<u>Actual Project Costs</u>		
		<u>Total Costs</u>	<u>Total Mileage</u>	<u>Cost Per Mile</u>
1971	62	\$ 6,964,025	302.972	\$ 22,986
1973	44	\$ 6,446,141	220.635	\$ 29,216
1975	59	\$10,020,099	251.414	\$ 39,855
1977	79	\$12,900,231	307.899	\$ 41,898
1979	99	\$14,291,359	296.013	\$ 48,279

Percent Increase 1971 to 1979: 110%.

A-Funded Primary Road Contracts

<u>Year</u>	<u>Number of Projects</u>	<u>Actual Project Costs</u>		
		<u>Total Costs</u>	<u>Total Mileage</u>	<u>Cost Per Mile</u>
1971	8	\$ 2,663,804	12.535	\$212,509
1973	9	\$ 5,999,125	31.503	\$190,430
1975	37	\$24,401,612	108.569	\$224,757
1977	27	\$21,605,320	75.179	\$287,385
1979	11	\$ 5,214,415	15.826	\$329,484

Percent Increase 1971 to 1979: 55%.

TABLE 3 (CONTINUED)

Resurfacing Contracts

<u>Year</u>	<u>Number of Projects</u>	<u>Actual Project Costs</u>		
		<u>Total Costs</u>	<u>Total Mileage</u>	<u>Cost Per Mile</u>
1971	10	\$ 2,090,235	255.737	\$ 8,173
1973	10	\$ 1,475,995	151.118	\$ 9,767
1975	6	\$ 695,308	57.718	\$ 12,047
1977	8	\$ 1,618,941	151.497	\$ 10,686
1979	10	\$ 843,178	80.419	\$ 10,485

Percent Increase 1971 to 1979: 28%.

Note: Since contracts are let one year or more before the roads are completed, the actual cost figures will lag behind the bid estimates received on new contracts (see Table 2).

Cost categories of State primary, secondary and resurfacing contracts, established by the Deputy State Highway Engineer, were used by LAC as measurements to determine what items within road projects are causing costs to increase. The Council randomly selected 46 State primary, 50 secondary and 44 resurfacing contracts which were completed in odd years during the decade 1970 to 1980. The following tables show the dollar totals of the cost categories for the secondary and primary projects and the average cost per mile for the resurfacing projects.

TABLE 4
AVERAGE COST PER MILE BY CATEGORY ON 50 C-FUNDED
STATE SECONDARY ROADS 1970-1980

	<u>1971</u>	<u>1973</u>	<u>1975</u>	<u>1977</u>	<u>1979</u>	<u>% Change 1971 to 1979</u>
Number of Contracts	10	10	10	10	10	
Miles Paved in Sample	56.479	44.300	37.921	40.027	27.427	
Total Cost	\$1,528,324	\$1,320,946	\$1,301,854	\$1,855,438	\$1,184,313	
Total Average Cost Per Mile	27,060	29,818	34,331	46,355	43,181	60%
<u>Cost Per Mile by Category¹</u>						
Clearing and Grubbing	\$ 2,914	\$ 3,578	\$ 4,512	\$ 5,401	\$ 4,595	58%
Surface Preparation	13,529	10,456	14,075	19,727	13,935	3%
Paving	5,163	9,043	8,286	11,926	12,388	140%
Equipment/Materials	4,525	4,596	5,632	5,580	9,479	109%
Other	<u>929</u>	<u>2,145</u>	<u>1,826</u>	<u>3,721</u>	<u>2,784</u>	200%
TOTAL	\$ 27,060	\$ 29,818	\$ 34,331	\$ 46,355	\$ 43,181	

¹See Appendix C for percent each cost category is of the total cost.

TABLE 5
AVERAGE COST PER MILE BY CATEGORY ON '46 A-FUNDED
STATE PRIMARY ROADS 1970-1980

	<u>1971</u>	<u>1973</u>	<u>1975</u>	<u>1977</u>	<u>1979</u>	<u>% Change 1971 to 1979</u>
Number of Contracts	8	8	10	10	10	
Miles Paved in Sample	12.535	26.698	13.736	19.471	11.150	
Total Cost	\$2,663,804	\$5,172,866	\$4,431,831	\$6,394,675	\$3,614,945	
Total Average Cost Per Mile	212,509	193,755	322,643	328,420	324,210	53%
<u>Cost Per Mile by Category</u> ¹						
Clearing and Grubbing	\$ 16,576	\$ 18,049	\$ 23,023	\$ 22,155	\$ 18,961	14%
Surface Preparation	83,998	58,554	81,962	65,765	60,603	-28%
Paving	47,599	73,414	120,215	127,382	133,242	180%
Structures	12,769	5,235	5,863	21,540	17,120	34%
Equipment/Materials	20,814	19,081	42,598	38,326	49,714	139%
Masonry	2,030	39	3,793	4,832	1,751	-14%
Other	<u>28,723</u>	<u>19,383</u>	<u>45,189</u>	<u>48,420</u>	<u>42,819</u>	49%
TOTAL	\$ 212,509	\$ 193,755	\$ 322,643	\$ 328,420	\$ 324,210	

¹See Appendix C for the percent each cost category is of the total cost.

TABLE 6

AVERAGE COST PER MILE BY CATEGORY ON 44 STATE RESURFACING CONTRACTS

	<u>1971</u>	<u>1973</u>	<u>1975</u>	<u>1977</u>	<u>1979</u>	<u>% Change 1971 to 1979</u>
Number of Contracts	10	10	6	8	10	
Miles Paved in Sample	255.737	151.118	57.718	151.497	80.419	
Total Cost	\$2,090,235	\$1,475,995	\$ 695,308	\$1,618,941	\$ 843,178	
Total Average Cost Per Mile	8,173	9,767	12,047	10,686	10,485	28%

Primary projects show from 1970 to 1980, paving, equipment and materials categories as increasing while surface preparation and clearing and grubbing are declining. The remaining three categories changed very little in the same period. On secondary projects increases occurred in paving, equipment and materials and the other categories while surface preparation declined and clearing and grubbing remained constant. The resurfacing sample did not show the same type of results as these projects have only categories consisting of the type of asphalt pavement used on the roads. Appendix C shows the percent each category is of the total cost and the different types of pavement used in resurfacing projects.

As a final test of the road paving program, the Council compared the actual costs of the 46 State primary and 50 secondary road projects, used in the cost category sample, to the bid estimates submitted by the contractors. This was done to check for cost overruns on road construction contracts. The 44 resurfacing contracts were not tested because of the small number of categories.

The test found that actual costs exceeded the bid by only 3.9% on State Primary projects and on State Secondary roads the actual costs were 1.7% under the bid estimates.

TABLE 7
BIDS COMPARED TO ACTUAL COSTS ON STATE
SECONDARY AND PRIMARY ROAD PROJECTS*

<u>Project</u>	<u>Number of Contracts</u>	<u>Actual Cost of Contracts</u>	<u>Bids Received on Contracts</u>	<u>Dollar Difference</u>	<u>Percentage Difference</u>
Secondary	50	\$12,860,830	\$13,080,961	-\$ 220,131	-1.7
Primary	46	\$34,245,332	\$32,961,611	\$1,283,721	3.9

*Based on LAC's Sample 1970-1980

LAC attempted to examine Federal-aid secondary, primary and interstate contracts but found that too few samples existed for the Federal-aid to State secondary and primary roads to draw any valid conclusions. On the interstate projects, the Council learned that these contracts are let in "stages" over a period of years. This procedure is not conducive to comparing the costs of constructing a mile of interstate highway to a mile of State primary, secondary or even, another interstate highway.

Materials and Equipment Costs to Contractors

As part of its examination of road paving projects, the Council looked into the costs of materials and equipment used in road construction. Factors such as the cost of asphalt, paving equipment, plant equipment, stone and other materials, labor, and workmen's compensation rates were examined. This research was done to learn how much costs have risen for road paving contractors because these costs are reflected in the bids submitted on State highway projects.

During its research the Council found that two categories, oil based products and equipment and materials, increased greatly in price from 1970 to 1980 (see Table 8). An analysis of materials and equipment costs showed a correlation between the rising price of asphalt and paving costs, and the rising price of equipment and increasing equipment costs in contracts. Although all price increases were not as large, overall the prices paid by contractors for all items used in their business increased steadily between 1970 and 1980.

Another factor which has a direct impact on costs is productivity. In its interviews with asphalt paving contractors, the South Carolina Asphalt Pavement Association and the State Highway Department, LAC learned that productivity has decreased over the past ten years.

The technology of road construction has not advanced very rapidly in the past ten years in the paving industry. Some technological changes have been developed primarily in the field of safety devices added to existing equipment. Some changes, such as replacing manual transmissions with automatic transmissions on equipment have also occurred. But, important changes, such as equipment which requires fewer laborers on the job or which increases productivity have not been developed.

One reason for declining productivity is the nature of road construction work. Road construction is a volume oriented enterprise where productivity increases if wide, long stretches of road are constructed or paved. These projects, such as interstate roads, permit the contractor to concentrate his work force, use his large equipment efficiently by handling large volumes of excavation work or paving, and allow the laborers to work unimpeded by such things as traffic operating on the road. In recent years the large projects in South Carolina have

ended. The interstate system is almost complete or under construction, and of the 10,000 miles authorized by law for the State Primary system, 9,343 miles have been built.

Increasingly, the Highway Department's road construction contracts have consisted of small lengths of roads. The Department puts these segments into one contract in order to have at least three miles of roads for contractors to bid. Three miles is considered necessary in order to make a contract worthwhile for a contractor to bid. This practice also reflects the decreasing number of major roads that need to be built in South Carolina. In addition, it causes the costs of construction to rise because a contractor can no longer mobilize his work force and equipment and concentrate them in one area. The contractor must constantly move his workers and equipment around the county or from one county to another to pave the small lengths of roads in the contract. Also, since small lengths of roads are built, the volume of work on any one length of road is diminished.

Another factor of road construction cost is the size of a work crew needed to pave a mile of road. Asphalt paving contractors told LAC that it takes a 12 to 20 man crew to pave a mile of road and that work force size has not decreased in 20 years or more. The variance in size of the road paving crew will depend on the type of road paved and the area in which it is located. The reasons for this stability of the work force size are the labor intensive demands of road building and the growing number of safety rules which require personnel to work as flagmen routing traffic around job sites.

As mentioned, crew size will depend upon the area the contractor works. The urban area projects require more personnel than rural

projects. Interstate roads require only a minimum number of employees because a large area is being paved and there are no traffic problems to hinder the project. Along with the type and location of a road project, the thickness of the pavement under construction also affects the size of a work crew needed. Generally, the thicker the asphalt, the fewer workers are required to put it down. The thinner pavement projects require more workers because more asphalt paving machines are needed to spread the asphalt over a longer distance.

One area in which technological advances have occurred in the road construction industry is asphalt plant technology. Over the past 15 years improvements have been made to asphalt plants which have increased asphalt production and permitted better quality control over the product. The industry has changed from "continuous mix" plants to either "batch" or "drum" mix plants. However, these changes have not reduced the cost of a plant due to the environmental and other regulations which have necessitated the addition of pollution and other equipment to the plant. For example, a "batch" mix plant which yields 4,000 to 6,000 pounds of asphalt costs approximately \$260,000 in 1970, \$375,000 in 1975 and \$630,000 in 1980, a 142% increase in ten years.

A new plant's cost is but one factor in the increasing cost of road construction. The rising cost of oil over the past decade has caused the price of asphalt to increase rapidly. For a number of years prior to 1973, the price of oil remained constant with few price changes. Beginning in the 1970's, this constant price began to rise steadily and quickly causing price increases in oil-based products. An example of this is the price of a ton of AC-20 Grade Asphalt Cement (see Table 8) manufactured to Highway Department standards and the price of Type CRS-2 Asphalt Emulsion.

Since prices for asphalt cement and emulsion reflect only part of the costs a contractor must consider when he bids on a Highway Department contract, the Council looked at the prices of some other items used in road construction. Table 8 shows the average prices of various materials needed in road paving work for the years 1970, 1975 and 1980.

TABLE 8

AVERAGE PRICES OF SELECTED ROAD PAVING MATERIALS 1970-1980

Item	Price			Price Increase 1970-1980	
	1970	1975	1980	Dollars	Percent
1. Ton of AC-20 Grade Asphalt Cement:	\$27.33	\$71.83	\$141.33	\$114.00	417%
2. Gallon of CRS-2 Asphalt Emulsion:	.0879	.2755	.5746	.4867	554%
3. Ton of Type I Portland Cement:	20.22	31.20	48.67	28.45	141%
4. Cubic Yard of Class A Concrete:	18.38	27.18	42.54	24.16	131%
5. Cwt. of Reinforcing Steel:	9.75	15.50	18.00	8.25	85%
6. Aggregate: (Per Ton)					
CR-14	1.52	2.04	3.06	1.54	101%
5	2.08	2.78	4.95	2.87	138%
57	2.10	2.77	4.50	2.40	114%
6M	2.14	3.01	4.93	2.79	130%
8M	2.13	3.90	5.88	3.75	176%
789	2.26	3.20	5.48	3.22	142%
Screenings	1.05	1.51	1.94	.89	85%
7. Class III Concrete Pipe Per Lineal Foot:					
15"	1.95	3.27	4.20	2.25	115%
18"	2.53	4.25	5.50	2.97	117%
24"	3.75	6.53	8.57	4.82	129%
30"	6.08	9.95	13.23	7.15	118%
36"	8.18	13.73	18.10	9.92	121%
48"	13.63	22.63	30.10	16.47	121%
60"	21.70	34.32	45.80	24.10	111%

Source: Private contractors and materials suppliers.

The Council also reviewed the cost of equipment to contractors. The Asphalt Pavement Association provided LAC with a list of equipment needed by asphalt pavement contractors to operate their business. By contacting equipment dealers and contractors, the Council was able to obtain some price trends for certain pieces of equipment used by asphalt pavement contractors. Table 9 shows a list of approximate prices for equipment for the years 1970, 1975 and 1980.

TABLE 9
APPROXIMATE PRICES CHARGED FOR SELECTED
EQUIPMENT USED BY ASPHALT PAVEMENT CONTRACTORS

<u>Equipment</u>	<u>1970</u>	<u>1975</u>	<u>1980</u>	<u>% Change 1970-1980</u>
Paver	\$44,000	\$65,000	\$100,000	127%
8-12 Ton Roller	16,000	24,000	32,000	100%
Front-end Loader 3½ C.Y.	49,250	79,830	137,420	179%
15 Ton Truck	19,500	Not avail.	40,000	105%
Truck Dump Body	1,500	Not avail.	4,500	200%
Tractor with Broom	4,000	8,000	12,000	200%

Source: Private contractors and equipment suppliers.

The Council also gathered information on wages and workmen's compensation rates paid by contractors. The South Carolina Employment Security Commission was able to provide the Council with information on wages paid to road and heavy construction workers. This information was available only for the years 1975 through 1980 and is displayed in Tables 10 and 11.

TABLE 10
AVERAGE WEEKLY WAGE PAID TO ROAD CONSTRUCTION
WORKERS IN SOUTH CAROLINA 1975-1979

<u>Road Construction Workers</u>	<u>1975</u>	<u>1979</u>	<u>Percent Increase</u>
Highway and Street	\$163	\$212	30%
Heavy Construction	\$202	\$235	16%

Source: South Carolina Employment Security Commission.

TABLE 11
WORKMEN'S COMPENSATION RATES FOR STREET AND ROAD
CONSTRUCTION WORKERS (PER \$100 OF SALARY) 1970-1980

<u>Rate Per \$100</u>	<u>1970</u>	<u>1980</u>	<u>Percent Increase</u>
Paving, Repaving Workers and Drivers (Skilled)	\$3.43	\$6.91	101%
Sub-surface Workers and Workers (Unskilled)	\$3.30	\$6.56	99%

Source: South Carolina Compensation Rating Bureau.

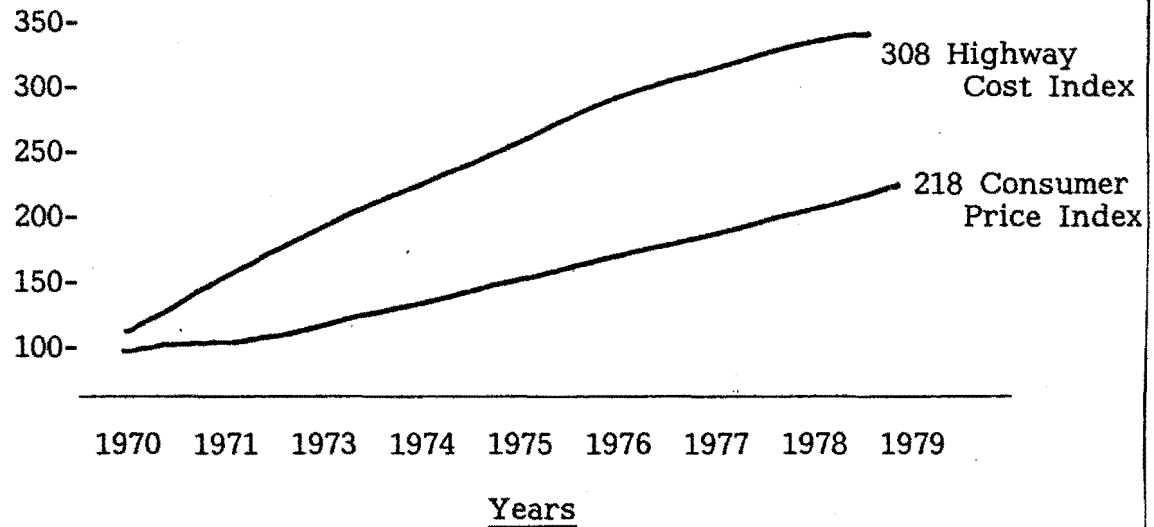
Conclusion

Finally, as an indicator of how costs have risen in highway construction work, the Highway Users Federation has estimated that road construction costs exceed the inflationary spiral of the National Consumer Price Index over the past ten years by 41%. Illustration 1 shows the percentage increase in road construction costs over the Consumer Price Index.

ILLUSTRATION 1

HIGHWAY CONSTRUCTION COST VS. CONSUMER PRICE INDEX

1970-1979



Sources: Highway Users Federation.
U. S. Federal Highway Administration.
U. S. Department of Labor.

Over the past ten years the overall cost of staying in the road construction business has increased at a rapid rate. In turn these costs are reflected in the increasing costs of highway construction which is growing faster than the National Consumer Price Index.

Alternative Methods of Road Paving

During its audit of the Highway Department, the Council examined the possibility of county governments paving roads more economically than private contractors. The Council found that the majority of the counties lack the technical expertise and resources to construct and

pave roads. A sampling of projects contracted with the Highway Department by county governments showed that counties with the ability to pave roads do not necessarily pave roads cheaper than private contractors.

Many counties do not have the tax base or stable sources of funds to finance road construction operations. Many are hard pressed to meet the budgets of their road maintenance departments and must rely on a combination of the State's gasoline tax rebate, Highway Patrol fines and levies, county tax revenue and Federal funds to support their road maintenance operations. In addition, many counties must rely on prison labor to aid in the upkeep of their roads and they delay replacing old road equipment because of budget constraints.

To learn what road paving and maintenance capabilities exists in the State's counties, the Audit Council surveyed South Carolina's 46 county administrators, supervisors and managers. The Council received 43 replies and learned that 11 counties have the capability to pave roads. Five of the counties, Beaufort, Florence, Richland, Sumter and York said their road paving departments have contracts with the Highway Department for road work. In addition, Allendale County told LAC they have contracted with the Department to perform repairs on a bridge in the county.

The Council examined 92 State primary and 343 State secondary road projects completed between 1971 and 1979. Of these 92 primary and 343 secondary road projects, county governments contracted to build only one primary road project and 15 secondary road projects. In order to determine if counties performed road work more economically than private contractors, the Council compared payments made by

the State Highway Department to county governments and private contractors for construction projects. A comparison of the payments made for each mile of road constructed indicated that counties could perform the work more economically (see Table 12). However, the Council found that there were other costs to the counties that the cost-per-mile figures did not include.

TABLE 12
COMPARISON OF SECONDARY ROAD PROJECT COSTS TO THE
STATE BETWEEN PRIVATE CONTRACTORS AND
COUNTY GOVERNMENTS 1971-1979

<u>Year</u>	<u>Number of Projects</u>	<u>Average Cost Per Mile</u>		
		<u>Private Contractors Average Cost Per Mile</u>	<u>Number of Projects</u>	<u>County Governments Average Cost Per Mile</u>
1971	59	\$23,585.19	3	\$14,582.52
1973	42	29,687.51	2	12,009.61
1975	54	40,951.42	5	21,026.49
1977	77	42,032.53	2	33,048.33
1979	96	48,499.80	3	36,864.89

Note: The costs only show the amount the State Highway Department paid to have a mile of road paved. Cost figures do not necessarily reflect all the costs incurred by county governments for road paving. This is because some of the counties' costs have been borne by other sources, such as labor performed by CETA workers who are paid with Federal funds. The payment made to private contractors must cover all costs or they would not be able to stay in business.

Although the statistics appear to show that county governments pave roads cheaper than private contractors, further analysis reveals that these cost figures are misleading. County governments must rely on various Federal, State and local sources of funds to finance their budgets. LAC's survey found that counties will use one or all of these sources to fund their road departments. More importantly, counties will use revenue such as Federal revenue sharing funds to buy equipment, CETA workers to augment their road work force and use prison labor on their maintenance work crews. Often these costs are not computed when a county prepares its road department's budget or not factored into any cost accounting of road paving or maintenance cost. This method does not take into account all of the costs associated with a road paving operation, costs which a private contractor must consider if he is to meet his expenses and show a profit to stay in business. Table 13 shows the counties which told the Council they have the ability to pave roads or contract with the Department.

TABLE 13
COUNTY PAVING OPERATIONS

<u>County</u>	<u>Source of Funds</u>			<u>Use Prison Labor in in County Operations</u>	
	<u>Federal</u>	<u>State</u>	<u>County</u>	<u>Yes</u>	<u>No</u>
Anderson		x	x	x	
Berkeley		x	x	x	
Greenville		x	x	x	x
Greenwood	x	x	x		x
Horry		x	x	x	
Laurens		x	x		x
Oconee	x	x	x	x	
Pickens		x	x	x	
Richland		x	x		x
Spartanburg		x	x		x
Sumter*	x	x	x	x	
Union		x	x	x	
York*	x	x	x	x	

*York and Sumter Counties told LAC that they do not have the ability to pave roads but on rare occasions will pave a small length of industrial road.

In 1977, Lexington County experimented with establishing a county paving operation. The County Council appropriated \$250,000 in Federal revenue sharing funds for this operation and paved two roads, one .405 mile in length at a cost of \$42,470 and the other .405 mile in length for \$42,000. After the experiment, the County Council decided it was not cheaper for the county to pave roads than have the Highway Department contract road projects to private contractors. The Lexington Council learned that the county did not have the technical expertise to design roads, acquire right-of-way rights, and exercise eminent domain on private property. After this experiment, the Lexington County Council decided not to establish a road paving operation in the County.

Before a county enters into a road paving operation, it must consider the cost of setting up such an operation against the cost of building roads and the volume of work available within its boundaries. All costs, such as purchasing equipment with Federal funds, using federally-funded CETA workers, etc., need to be considered to accurately project how much a county will spend to run a road paving operation. These costs must be known before a county takes on this burden. Rural counties especially, are not in the best financial position to fund the large equipment purchases and other expenditures encumbered by road paving operations.

Alternative Materials and Techniques

As part of the General Assembly's audit request, the Audit Council examined various experimental materials and techniques used to hold down the cost of road paving. This examination consisted primarily of interviewing various officials in the paving industry, Federal Government,

and State Highway Department. Both the paving industry and the Highway Department finance research of alternative materials and techniques in road paving work.

Nationally, the American Association of State Highways and Transportation Officials has a laboratory for road tests in Ottawa, Illinois, and the United States Department of Transportation also conducts research on roads through its Region 15 office. In South Carolina, the Highway Department funds a research division and in 1980 spent \$148,000 for highway research contracts to various universities.

The road paving industry has made advances in asphalt plant technology (see p. 35) while equipment improvements have lagged (see p. 33). In the area of road pavements, both the industry and the Department have experimented with various alternatives to using asphalt on a road surface and with other materials to construct the base of a road. While some of these experiments have proven successful, there are drawbacks to the new techniques as well. The following is a list of some of the alternative materials and techniques along with a description of the strengths and weaknesses of each method.

Cold Mix Asphalt

This method uses an asphalt emulsion rather than heat to mix the asphalt. Savings are gained because the energy used to heat the asphalt is reduced. This method is used in New York, Michigan and Indiana and the United States Park Service paves some of its roads with cold mix asphalt. South Carolina will lay a test strip in 1981 to test its applicability in the State. Cold mix asphalt can only be put down when the weather is warm and dry and when traffic is not allowed to operate for a time to allow the road to cure.

Sulfur Mix Asphalt

The method combines a 50/50 or 30/70 mix of sulfur with asphalt cement to reduce the amount of asphalt needed in a road surface. This method may prove a boon to the paving industry because of the projected increase in the use of coal in the United States and sulfur is a by-product of the oil refining process. The Highway Department is currently experimenting with a 30/70 mixture of sulfur/asphalt in one of its projects. The problems with sulfur are its cost is as high as oil, the major sources of supply are outside the United States, the major oil companies have control over these sources and the agricultural industry uses large amounts of sulfur for fertilizer.

Recycled Pavement

This method uses an old road's asphalt surface to manufacture a new surface. A machine chews up the old road surface, dumps it into a dump truck, and the truck takes it to an asphalt plant where the recycled material is mixed with sand and asphalt cement to make new asphalt. This method is used extensively in Florida and the western states. South Carolina has not experimented with this method because of a lack of expertise and the State's plentiful supply of aggregate. Recycling asphalt pavement is financially feasible when aggregates are scarce, as in Florida, or must be transported over a long distance to the asphalt manufacturing site, as in the western states. Scarcity of aggregate or long hauling distances for aggregates makes the cost of recycling asphalt cheaper than the cost of using aggregate to produce new asphalt.

Thin Lift Sand Asphalt Surface Mix

The Department has used this method since 1971 and has been successful in holding down the cost of resurfacing some roads. This method substitutes sand for crushed stone and is used only on lightly traveled, rural secondary roads which are in good shape. The road can be overlaid to produce a smooth surface, it is sealed against water, ruts are filled and its life is extended eight to ten years.

Along with pavement structures, the Highway Department is experimenting with new materials or techniques of constructing the base of a road. These techniques are used to attempt to hold down the cost of building a road while not reducing the quality of its base which is essential to good road construction.

Lean Concrete Base Course

This method uses a smaller amount of Portland Cement and a larger, less costly aggregate for the base course. By using a lean concrete base course, the cost of the pavement structure on the road is held down.

Cement Modified Subgrade

The Department is using this method on the new construction of Interstate I-77 from Columbia to Charlotte, North Carolina. The subgrade soil of the road is mixed with cement to form the road's base course. As a result not as much pavement structure is required to finish the road and the project is not delayed by wet weather as conventional base course construction.

Coquina Base Materials

This is a loose mixture of sand and shell used as a base material on some roads. It allows a contractor to use a less expensive material for the base course of the road. Its major drawback is that the Coquina is found only in the lower part of the State and is not very plentiful.

Limestone

This material has proven successful as a base course and the Department has specified its use. Like Coquina, it is a less expensive base course material, but, with limestone there are a limited number of sources in the State.

These alternative materials and techniques to current road paving practices are but a few of the numerous experimental materials and methods being researched in the field of road construction. As an example of the enormity of this research, the Council examined the 1979 World Survey of Research and Development on Roads and Road Transport prepared by the International Road Federation. The report contained an inventory of 54 countries conducting research and experiments on road construction methods and materials.

Alternative materials and methods are constantly tested in South Carolina. What will eventually work to produce cost savings in road construction depends on a number of variables such as time, location and type of road, alternative materials available, and other factors. To date no one material or method has been developed to totally replace the current practices of building roads.

CHAPTER III

MANAGEMENT OF ROAD CONSTRUCTION PROGRAMS

Introduction

This chapter contains a review of various aspects of the South Carolina Department of Highways and Public Transportation (SCDHPT) road management procedures. Emphasis is placed on road construction practices and maintenance procedures which affect the conditions of the State's highways. Where a deficiency is noted, an explanation is provided with recommendations for correction or improvement.

SCDHPT is Unable to Maintain the State's Highways

Introduction

In 1970, South Carolina had 35,576 miles in its highway system including interstate, primary and secondary roads. On January 1, 1980, the State had 39,294 miles, an average yearly increase of 372 miles of road over the past ten years. This growth has primarily been in the State's secondary road system. Each year the State added an average of 25 miles to its interstate road system, 19 miles to its primary system and 290 miles to its secondary system. This disparity will increase in the 1980's as the interstate construction program comes to an end and the State's primary road system is completed. Interstate roads are designed to last 20 years, primary roads 12 to 15 years and secondary roads 15 to 20 years, with the pavement design life varying according to such factors as changes in traffic count, physical conditions surrounding the road, type and thickness of the pavement, and weather.

The State's highway program has reached a point where there are a number of critical choices to be made. The decisions made and the directions chosen will shape the highway program for at least the next decade. Currently, South Carolina ranks fifth in the nation in miles of roads in its State highway system. This system continues to grow each year while the miles of road that reach the end of their design life increase and the yearly revenue to build and maintain the system decreases. Declining revenue and rising costs now require the State to decide what its priorities will be for the future. The question is whether the State can afford to continue adding mileage each year to its road system while an increasingly large portion of the existing roads need resurfacing and a decreasing amount of resurfacing is done each year.

Secondary Road Construction

The South Carolina Department of Highways and Public Transportation (SCDHPT) is constructing and accepting more roads into the State's highway system than it can properly maintain. While more roads are accepted into the system each year, fewer miles are resurfaced and many are reaching the end of their designed pavement life.

As of July 1980, the Highway Department estimates that 5,727 miles or 15% of the State's road system needs to be resurfaced. These roads have reached the point in their design life where ordinary maintenance can no longer restore pavement life and resurfacing is needed to prevent deterioration.

Typical road maintenance activities include patching potholes, filling cracks and joints, street cleaning, drainage repair and cleaning, snow removal, shoulder repair, grass cutting, etc. The objective of

maintenance is to correct minor deficiencies, not replace or rehabilitate extensive sections of pavement which have reached the end of their useful life. When major segments of a highway system have reached this point, maintenance activities cannot be substituted for resurfacing. It is more cost effective, from a maintenance standpoint, to devote minor repair efforts to roads that are not in need of major improvement.

During the 1970's, the State resurfaced 9,730 miles of road, a yearly average of 973 miles, a two to three percent average of the total roads in the State. At this rate roads are resurfaced about every 40 years. Road pavements with a design life of 15 to 20 years must wait twice that long before their surface is restored.

In 1947, the General Assembly passed South Carolina Codes, Sections 12-27-400 and 57-5-70. These two pieces of legislation had the effect of modernizing the State's rural, secondary road system by establishing a method to finance "farm to market" road construction and providing for the acceptance of these roads into the State's road network for maintenance. South Carolina Code, Section 12-27-400 apportions a certain amount of the State's gasoline tax, 2.16 cents of the 11 cents tax, for the construction, improvement, and maintenance of "farm to market" roads, known as "C" roads from the Department's funding codes. The County Legislative Delegations choose which roads are to be paved in individual counties and the Department constructs them as funds become available. The intent of this legislation was to develop a modern, rural secondary road network from the local, county maintained dirt road system existing at the time. As Highway Department officials told the Council, this legislation was designed, "to get the farmer out of the mud." Over the past 30 years this program has worked to achieve this goal. By the late 1970's, the State had largely completed a

network of paved, rural secondary roads and new secondary road construction was losing its "farm to market" characteristics. Increasingly, secondary "C" funded road contracts were let for subdivision, urban and small town types of streets (see p. 22).

During its review, the Audit Council examined the distribution of "C" funds among road paving, resurfacing, bridges and sidewalk projects for the years 1970 to 1980. The purpose of this examination was to determine what portion of the funds was going to new road construction and other types of projects. The Council found 89% to 97% of the "C" funds were spent for new road construction while three to nine percent went for resurfacing and two percent or less went to the remaining categories. The following table shows the distribution of "C" funds for secondary roads among the various categories.

TABLE 14
PERCENTAGE DISTRIBUTION OF "C" FUNDS AMONG
TYPES OF ROAD PROJECTS 1970-1980

<u>Categories</u>	<u>Year</u>				
	<u>1971</u>	<u>1973</u>	<u>1975</u>	<u>1977</u>	<u>1979</u>
Road Paving	90%	97%	95%	93%	89%
Resurfacing	9	3	5	7	9
Bridges	*	*	*	*	2
Sidewalks	<u>1</u>	<u>*</u>	<u>*</u>	<u>*</u>	<u>*</u>
TOTAL	100%	100%	100%	100%	100%

*Less than 0.5%.

During the next five fiscal years (FY 80-81 to FY 84-85), the Highway Department estimates that expenditures will decrease from \$30.8 to \$26.5 million for the "farm to market" C-fund program due to the expected decrease in gasoline tax revenue. If these expenditures follow the pattern of the past ten years, approximately 90% of this money will go to constructing new roads adding more roads to the State's highway system.

South Carolina Codes, Sections 57-11-40 and 57-11-50 establish priorities for the expenditures of the State Motor Fuel Tax by the Highway Department during a fiscal year. Section 57-11-50 states that after the Department pays for the retirement of its bonds and operating expenses it will appropriate,

...a sum sufficient to maintain the highways of the State highway system for such year in a sound and serviceable condition. [Emphasis Added]

Based upon the law funds should be used to preserve the existing highway system before constructing new roads.

Section 12-27-400, which sets aside 2.16 cents of the Motor Fuel Tax for the "farm to market" road program, states that the funds can be spent for, "construction, improvements and maintenance..." [Emphasis Added]. These laws set the priorities for expenditures of the Motor Fuel Tax and will allow the Department to shift its emphasis from new road construction to resurfacing and maintaining the current secondary road network.

Resurfacing can restore 15 to 20 years to a road's life and in FY 80-81 to FY 84-85, the Department anticipates increasing its expenditures for resurfacing from \$10 million to \$15.3 million. Because of increasing costs, \$15.3 million will only resurface an estimated 588

miles. This is only one percent of the total network and is a decrease from the two to three percent yearly average of roads resurfaced during the past decade.

In 1980, it cost an average of \$20,384 to resurface a mile of primary and secondary road while constructing a mile of secondary road cost \$92,713 (see p. 23). Using this cost of resurfacing as a guide, the total cost to resurface the State's 5,727-mile backlog in 1980 would have been \$116,739,168. By comparison, if the \$30.8 million estimate in "C" funds for FY 80-81 were used to resurface existing roads, the State could restore 1,511 miles of road that need major improvements.

Without an adequate resurfacing program, the State's maintenance program is in jeopardy of being overwhelmed by the large scale repairs needed on the State's highways in the 1980's. When a road's pavement reaches the end of its design life, it must be resurfaced or total pavement failure quickly occurs. As more roads reach this point, pothole patching or other routine maintenance activities can no longer prevent pavement failure and the State's investment in its roads is lost.

RECOMMENDATIONS

THE GENERAL ASSEMBLY SHOULD CONSIDER
ADOPTING A JOINT RESOLUTION REDIRECTING
THE PRIORITIES FOR EXPENDITURES OF FUNDS
UNDER SOUTH CAROLINA CODES, SECTION
12-27-400. THIS RESOLUTION SHOULD CONSIDER
THE FOLLOWING OPTIONS IN ORDER TO REDUCE
THE STATE'S RESURFACING INVENTORY AND TO

ESTABLISH AN ADEQUATE RESURFACING PROGRAM
FOR THE STATE'S HIGHWAYS.

(1) THE GENERAL ASSEMBLY SHOULD DIRECT
THE DEPARTMENT TO REDIRECT ITS SPENDING
PRIORITIES ON THE STATE SECONDARY
ROAD PROGRAMS FROM NEW CONSTRUCTION
TO RESURFACING BASED ON A PERCENTAGE
OF THE FUNDS NEEDED TO ADEQUATELY
REDUCE THE BACKLOG OF ROADS THAT
NEED RESURFACING.

(2) A MORATORIUM ON C-FUNDED SECONDARY
ROAD CONSTRUCTION MIGHT BE CONSIDERED.
THIS MORATORIUM COULD BE FOR A PERIOD
OF TIME SUFFICIENT TO ALLOW THE HIGHWAY
DEPARTMENT TO SUBSTANTIALLY REDUCE
ITS RESURFACING BACKLOG. ONCE THIS
BACKLOG IS REDUCED, THE DEPARTMENT
SHOULD ESTABLISH CRITERIA FOR SETTING
ASIDE AN AMOUNT OF THE "FARM TO MARKET"
ROAD REVENUE TO FUND AN ADEQUATE
RESURFACING PROGRAM.

THE HIGHWAY DEPARTMENT, IN ACCORDANCE
WITH SOUTH CAROLINA CODES, SECTIONS 57-5-40
AND 57-11-50, SHOULD DECIDE WHICH ROADS

WILL BE RESURFACED AND IN COOPERATION
WITH LOCAL COUNTY GOVERNMENTS, DECIDE
WHICH ROADS WILL BE CONSTRUCTED AND
ACCEPTED INTO THE STATE HIGHWAY SYSTEM.

Need to Implement a Maintenance Management System

The South Carolina Department of Highways and Public Transportation has no systematic method of setting statewide road maintenance priorities. Instead, the Department has to rely primarily on its district and field maintenance engineers to determine the roads to be repaired. No effort is made to collect data or establish objective criteria for determining which repairs are most needed in the State's highway system.

SCDHPT officials told LAC that they doubted the ability of such a system to assist in adequately managing the State's road repair needs and that the Department's computer does not have the capability to handle such a system. However, the Council learned that the Department is instituting an Information Management System in its computer in September 1981. SCDHPT's computer operations director told LAC the Department's computer will then have the capability to institute a maintenance management system.

Over the past five fiscal years (FY 74-75 to FY 78-79) the Highway Department increased its expenditures for maintenance by 32% from \$48,448,456 to \$64,097,399. By FY 78-79, maintenance consumed 22% of the Department's total budget. During the next five fiscal years (FY 80-81 to FY 84-85), the Department estimates that maintenance will grow to a total of \$95.5 million or 49.6% of its anticipated \$192.4 million

total budget in FY 84-85. With such a large increase going to maintenance, the Department does not have a systematic method for determining repair priorities on the State's roads.

Maintenance management systems collect detailed information on roads such as age, pavement condition, design capabilities, rideability, traffic volume, travel speed and other engineering aspects of road conditions. This information is put into a computer and is used by policymakers to decide what types of services need to be provided to repair a road or improve its capability to handle traffic. It allows policymakers to set priorities for allocating scarce resources for the repair or improvement of roads based on objective criteria and with the statewide road network's needs in mind.

In January 1980, the Federal Highway Administration (FHWA) released a study of maintenance personnel and systems in the 50 states. For the ten southeastern states, the FHWA found that eight (Alabama, Florida, Georgia, Kentucky, Louisiana, North Carolina, Tennessee and Virginia) have instituted maintenance management systems. Mississippi reported that it is changing to the maintenance management system and only South Carolina does not have such a system.

Since SCDHPT anticipates resurfacing fewer roads in the future, the Department's maintenance division will be responsible for maintaining an increasing number of roads which actually need major improvements. The Department's maintenance division is trying to patch roads which have reached the end of their designed life. Without resurfacing, no amount of maintenance work will keep a road's pavement from deteriorating, and the State will lose its investment in the road. This places a burden on the Department's maintenance division to patch roads that require more substantial improvements.

The Department is facing this increased maintenance responsibility without the benefit of a modern, systematic method for determining the priority repair needs of the State's entire road network. In the 1980's, with revenue declining, the Department will need a more objective, systematic approach to allocating scarce resources if it is going to protect the State's \$2.6 billion investment in its highways.

RECOMMENDATION

THE HIGHWAY DEPARTMENT SHOULD ESTABLISH A MAINTENANCE MANAGEMENT SYSTEM. THE SYSTEM SHOULD HAVE OBJECTIVE CRITERIA FOR SETTING REPAIR PRIORITIES AND MAKING DECISIONS ON MAINTENANCE ACTIVITIES FOR THE ENTIRE STATE HIGHWAY NETWORK.

Weight Enforcement Program Is Inadequate

The South Carolina Department of Highways and Public Transportation has not provided enough weight enforcement personnel to adequately enforce truck weight laws. Of the ten southeastern states, South Carolina has the lowest number of weight enforcement personnel, the highest number of miles per weight enforcement person, and the second lowest amount of fines collected. In addition, South Carolina's fine structure is not as strict as North Carolina, Georgia, and Florida, and is less a deterrent to overweight trucks.

The Council also learned that heavy trucks, weighing within the legal weight limit, will operate on secondary streets not designed to

carry heavy loads, causing damage to the roads. Since it is economically unfeasible to build all roads to carry a high volume of heavy traffic, the Highway Department needs to direct some of its effort to controlling this damage.

The inadequate weight enforcement program results from a lack of emphasis by management. The weight enforcement division has nine permanent weigh stations with two under construction, and ten two-man crews to operate portable scales. Limited personnel in the weight enforcement division means that portable scales are used full-time but permanent weigh stations are operated only part-time. With only 27 employees, two permanent weigh stations are operated an average of 35 hours a week, leaving the other seven closed.

The Audit Council compared the weight enforcement programs in the 10 southeastern states and found that South Carolina has the lowest number of enforcement personnel. South Carolina has 27 employees while the other nine states average 153 employees. Each South Carolina weight enforcer is responsible for an average of 1,455 miles compared to a southeastern average of 225 miles. During the course of this audit, the Council noted that truck inspections are also performed by the Public Service Commission (PSC). When LAC conducts its upcoming Sunset review of the PSC, the Council will study this program to determine if any duplication of services exists and if the State will benefit by consolidating these two programs.

Table 15 shows the expenditures, mile coverage, and total fines collected by the southeastern states' weight enforcement divisions for FY 79-80.

TABLE 15

COMPARISON OF WEIGHT ENFORCEMENT DIVISIONS IN THE SOUTHEAST FOR FY 79-80

	<u>Weight Enforcement Expenditures</u>	<u>Number of Miles Enforced</u>	<u>Number of Enforcement Personnel</u>	<u>Miles Per Enforcer</u>	<u>Fines Collected</u>
Alabama	\$1,250,000	10,500	60	175	Not Available
Florida	\$3,000,000 ^a	13,886	117	119	\$3,800,000
Georgia	\$1,000,000 ^a	18,250	144	127	\$1,136,422
Kentucky	\$1,873,700	25,000	100	250	\$ 553,692
Louisiana	\$3,200,000	16,290	190	86	\$7,220,585 ^d
Mississippi	\$3,251,000	10,890	212	51	\$3,360,820
North Carolina	\$3,000,000 ^a	55,300	289	191	\$1,847,946
South Carolina	\$ 687,784 ^c	39,294	27	1,455	\$ 622,976
Tennessee	\$3,000,000 ^a	81,932	125	655	\$4,500,000
Virginia	\$1,000,000 ^{a,b}	52,000	140	371	\$1,000,000

^aEstimated Expenditures.

^bExcludes 40 State Police Enforcement Officers.

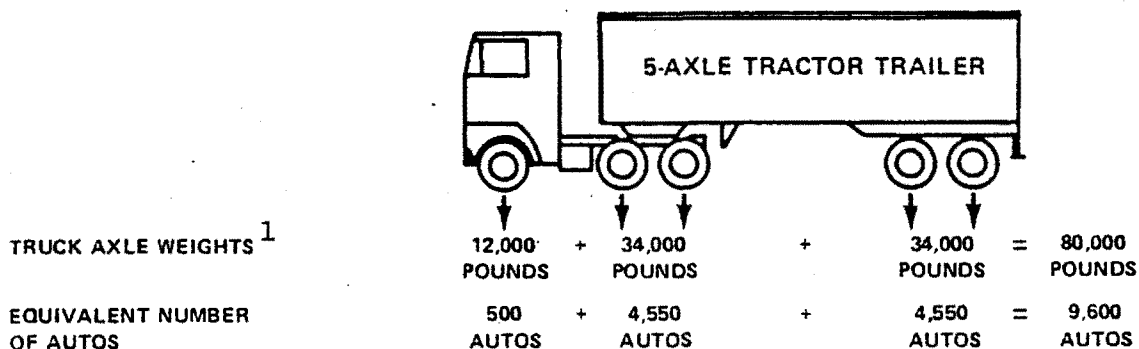
^cExcludes the purchase of non-expendable equipment.

^dIncludes overweight permits.

The Audit Council examined the fine structures for Georgia, North Carolina, and Florida. A truck 20,000 pounds overweight would be fined a maximum of \$1,000 in Florida, \$1,088 in Georgia, and \$830 in North Carolina. All of the fines would revert to the state. In South Carolina, the same truck would be fined only \$620. A maximum of \$100 would revert to the county and \$520 to the state.

The effectiveness of states' weight enforcement programs depends largely on the severity of fines. When overweight fines are less than the profits from routine overweight operations and the chances of getting caught are slim, fines become an acceptable cost of doing business. A good weight enforcement program requires effective enforcement techniques, stringent penalties, and adequate staff and funds. The impact of a heavy truck is disproportionately greater than the weight carried. The following diagram shows that a 5-axle, 80,000 pound tractor trailer has the impact of 9,600 automobiles, although it weighs about the same as 20 automobiles.

EQUIVALENT DAMAGE CAUSED BY LOADED
5-AXLE TRACTOR TRAILER



¹/Based on one automobile having two axles weighing 2,000 pounds each.

Source: July 1979 GAO Report, "Excessive Truck Weight: An Expensive Burden We Can No Longer Support."

The impact of heavy and overweight trucks makes it necessary to enforce weight limit laws in order to deter road damage. For heavy trucks operating on roads not designed to carry such weight, the Highway Department can use South Carolina Code, Section 57-7-10 as an enforcement tool. Section 57-7-10 gives the Department the right to require any person found guilty of damaging a road to pay the cost of restoring that road. For overweight trucks, increasing the amount of concentrated weight above legal limits will shorten the life of a road and accelerate the costs of maintenance and reconstruction. If roads are not manned more effectively and fines increased to deter weight limit violators, highways will deteriorate at an accelerated rate. This is at a time when South Carolina is confronted with major maintenance problems on the State's roads. Ensuring that weight limits are obeyed will prevent additional maintenance and reconstruction costs to South Carolina highways.

RECOMMENDATIONS

THE HIGHWAY DEPARTMENT SHOULD CAREFULLY
STUDY ITS STAFFING NEEDS IN ORDER TO ENSURE
TRUCK WEIGHT LAWS ARE ADEQUATELY ENFORCED
ON STATE HIGHWAYS .

CIVIL PENALTY FINES SHOULD BE INCREASED TO
ADEQUATELY DETER WEIGHT LIMIT VIOLATORS.

Providing Access Driveways to Private Property

The State Highway Department is constructing driveways from State roads to private property. In FY 77-78 to FY 79-80, the Department spent a minimum of \$13,598,339 of the State's Motor Fuel Tax revenue providing landowners with access to the State's roads. To install an access driveway, the Department digs a ditch, lays the culvert pipe which is provided free to the property owner, and covers it with dirt and gravel. The Department then paves the driveway from the shoulder of the road to the right-of-way line.

In FY 77-78, at the direction of the State Highway Engineer, the Department began placing an additional emphasis on paving driveways to the right-of-way line. Prior to this the Department had provided only the pipe and labor to install a driveway and cover it with dirt and gravel. If the Department had any asphalt left over from a paving operation, it would pave the driveway to the right-of-way.

In South Carolina, private property owners are given a 20-foot pipe and commercial owners a 40-foot pipe for installation by the Department who will install one driveway for the property owner. If the owner wants a second driveway, he must get a permit from the Department and have the driveway installed at his own expense.

To learn how other states handle driveway programs, the Audit Council surveyed the nine other southeastern states, Alabama, Florida, Georgia, Kentucky, North Carolina, Louisiana, Mississippi, Tennessee, and Virginia. There are three basic services that states may provide in constructing access drives.

- (1) Installing the access driveways, which includes installing a pipe, grading and filling over the pipe with dirt and gravel.

- (2) Paving over the pipe to the right-of-way line.
- (3) Providing free culvert pipe.

No state in the survey paves driveways to the right-of-way line. Alabama and Tennessee will pave only a "stub out" from the shoulder of the road to the entrance of the driveway. The other seven states did not provide any type of paving to a driveway.

Three states in the survey (Florida, Louisiana and Mississippi) did not install any driveways. Private and commercial driveway installation is the responsibility of the property owner and the states' only functions were to approve plans, issue permits and inspect the construction of driveways. None of the nine states installed commercial driveways. A business wanting access to a state's road is required to apply for a permit, submit detailed plans of its driveway, receive approval and be inspected by the state's highway department. Five of the states (Alabama, Georgia, Kentucky, Louisiana, and Tennessee) require businesses to post a bond as part of the requirements for installing a commercial driveway.

Five of the nine states (Alabama, Kentucky, North Carolina, Tennessee, and Virginia) require a private property owner to buy the pipe needed and get it to the location of the driveway. The states will install the pipe and cover it with dirt and gravel. Only Georgia provides free pipe to a private homeowner, installs it and covers it with dirt and gravel. No state gives the extent of free service as does South Carolina. The following table shows the services provided by the ten southeastern states for constructing driveways.

TABLE 16

SERVICES PROVIDED FOR CONSTRUCTING DRIVEWAYS
BY TEN SOUTHEASTERN STATES

State	Paves Driveways		Installs Private Driveways		Installs Commercial Driveways		Provides Pipe to Private Property Owner		Provides Pipe to Commercial Owner	
	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
Alabama		X ¹	X			X		X		X
Florida		X		X		X		X		X
Georgia		X	X			X	X			X
Kentucky		X	X			X		X		X
North Carolina		X	X			X		X		X
Louisiana		X		X		X		X		X
Mississippi		X		X		X		X		X
South Carolina	X		X		X ²		X		X ²	
Tennessee		X ¹	X			X		X		X
Virginia		X	X			X		X		X

¹Alabama and Tennessee will pave only a five-foot "stub out" from the shoulder of the road.

²South Carolina will install a commercial driveway located on secondary roads and will provide pipe to the commercial property owner.

Since the driveway paving program began in FY 77-78 to FY 79-80, the State has spent an average of \$4,532,780 per year installing culvert pipe and paving driveways. This cost is broken down into an average of \$2,143,042 for paving and \$2,389,738 for pipe and installation per year. The total expenditures for culvert pipe and installation were \$7,169,214, and paving was \$6,429,125 for FY 77-78 to FY 79-80.

Road construction is financed through the Motor Fuel Tax in order to have those who benefit from roads pay for their cost. The access driveway program benefits a few property owners at the expense of all citizens who pay the Motor Fuel Tax to finance the State's highways. Since the users of this service can be identified, the Department should have instituted a program whereby property owners do not receive special benefits at the expense of all taxpayers.

In its sample of resurfacing contracts, the Council found that it costs an average of \$20,384 per mile in 1980 to resurface a road in South Carolina (see p. 24). If the Department spent this \$4,532,780 for resurfacing, 222 additional miles of road could be resurfaced each year, an increase of 45% over FY 80-81's projected resurfacing mileage. This would aid the Department in reducing its large inventory of roads which need to be resurfaced.

RECOMMENDATIONS

THE DEPARTMENT SHOULD DISCONTINUE ITS
PROGRAM OF PAVING DRIVEWAYS TO THE
RIGHT-OF-WAY LINE AND PROVIDING FREE LABOR
AND PIPE FOR DRIVEWAY INSTALLATION.

DRIVEWAY INSTALLATION SHOULD BE THE RESPONSIBILITY OF THE PROPERTY OWNER AND THE DEPARTMENT SHOULD EXERCISE ONLY PLAN APPROVAL, PERMIT ISSUANCE AND INSPECTION AUTHORITY ACCORDING TO SOUTH CAROLINA CODES, SECTION 57-5-1080 AND 57-5-1090. THOSE DRIVEWAYS FAILING TO MEET THE STANDARDS ESTABLISHED BY THE DEPARTMENT SHOULD BE CLOSED IN ACCORDANCE WITH SOUTH CAROLINA CODES, SECTION 57-5-1110.

ONCE THE DRIVEWAY HAS BEEN BUILT TO STANDARDS, INSPECTED AND ACCEPTED BY THE DEPARTMENT, IT SHOULD BE THE DEPARTMENT'S RESPONSIBILITY TO MAINTAIN THE DRIVEWAY TO THE RIGHT-OF-WAY LINE. THE DEPARTMENT SHOULD PAVE A "STUB OUT" FROM THE SHOULDER OF THE ROAD TO THE ENTRANCE OF THE DRIVEWAY ONLY. SHOULD CONDITIONS ON THE ROAD CHANGE SO AS TO REQUIRE THE RELOCATION OR REMOVAL OF THE DRIVEWAY, IT SHOULD BE THE DEPARTMENT'S RESPONSIBILITY TO INSTALL A NEW ACCESS FOR THE PROPERTY OWNER.

Equipment Maintenance Program is Inefficient

The South Carolina Department of Highways and Public Transportation has an inefficient equipment maintenance program. The Department

spends considerable time and money repairing an aging maintenance fleet. The Audit Council found that the Department's downtime for equipment averages 19.5%. Downtime is the amount of time equipment is unused or idle awaiting parts and repairs.

Several factors explain the reason for the Department's inefficient equipment maintenance program. First, the SCDHPT does not have a central source of accurate information on the condition of the Department's equipment. LAC had to determine downtime from equipment work orders stored in boxes. The Department keeps neither downtime records nor depreciation schedules on its maintenance fleet. Without this information, equipment investments can be misallocated between the purchase of replacement equipment and the maintenance of the existing fleet. The amount allocated for equipment is determined by the Chief Commissioner, who has no formal means for determining equipment allocation.

In FY 80-81, South Carolina allocated less for equipment than six of the other nine southeastern states. Equipment allocations could not be determined for Georgia, North Carolina, and Virginia. The Department allocated 4% of its highway maintenance budget on equipment purchases compared to a six-state average of 10% for FY 80-81. At the request of the Audit Council, the Highway Maintenance Department compiled a list of commonly used maintenance equipment that should be replaced. According to the Department, 707 or 23% out of 3,036 equipment items needed replacing as of November 7, 1980. The current estimated replacement cost for this equipment is \$10,071,400.

A contributing factor to high downtime is the purchase of equipment on a low-bid basis without specification requirements that include

a supply of parts guarantee. With the existing low bid system, a diverse group of equipment is purchased, causing difficulty in finding spare parts for a wide range of equipment types.

The American Association of State Highway and Transportation Officials (AASHTO) has developed and established standards for equipment replacement. The Council compared the average age of the Department's equipment to AASHTO standards (see Table 17). This revealed that SCDHPT maintains a maintenance fleet with an average age that exceeds the recommended standards by one to five years.

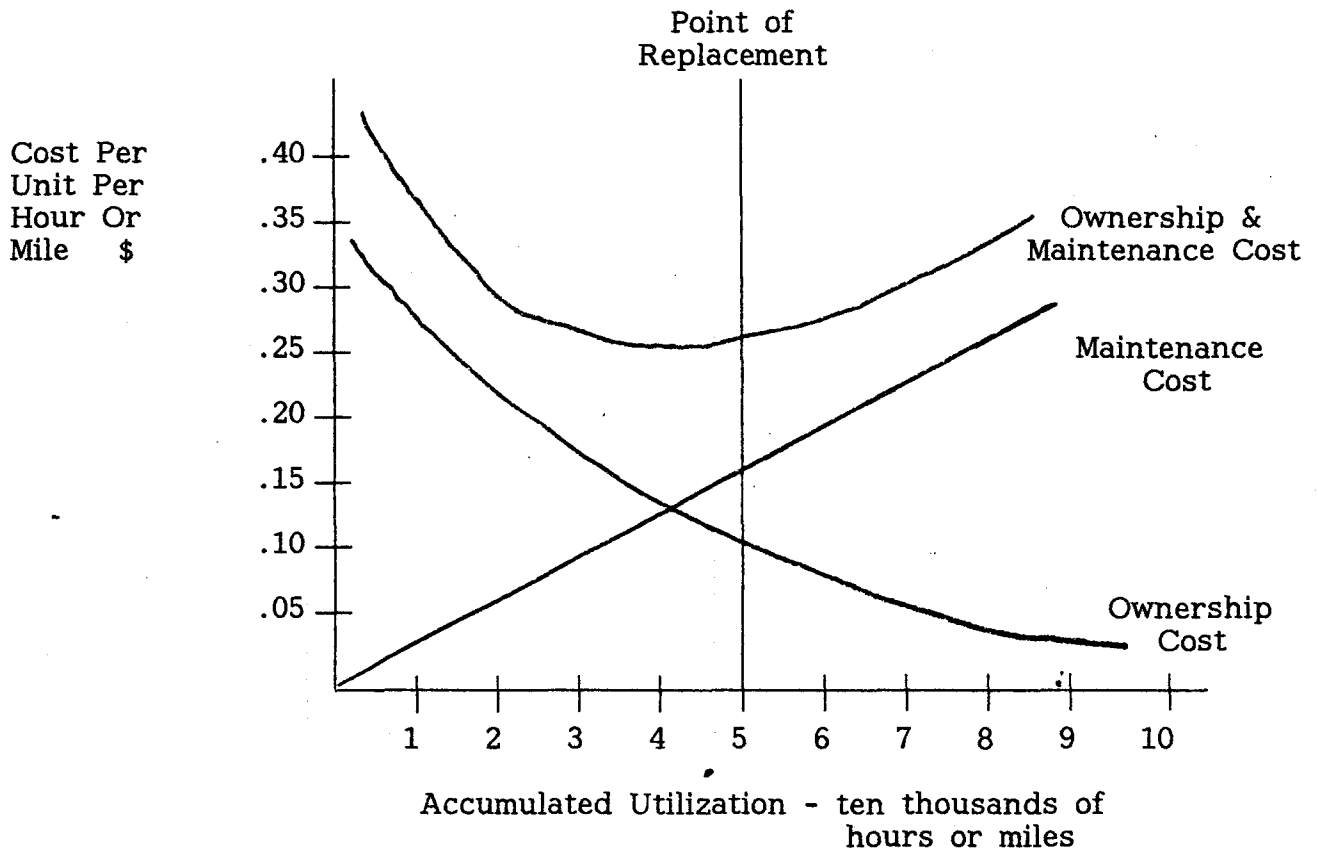
TABLE 17
COMPARISON OF DEPRECIATION STANDARDS WITH THE AVERAGE
AGE OF SELECTED TYPES OF EQUIPMENT IN SOUTH CAROLINA

<u>Type of Equipment</u>	<u>Years</u>	
	<u>AASHTO Depreciation Standards</u>	<u>South Carolina Average Age</u>
Grader, Motor	8	11
Loader, Wheel-type	6	11
Paver, Asphalt	8	9
Roller	7-10	13
Trucks, Multi-Use	5	8
Mower, Sickle-bar	5	7
Tractor, Wheel	6	9

A downtime of 19.5% also indicates South Carolina keeps its equipment longer than established industry standards. A 50-state study conducted in July 1978 by the New York Division of the Budget, shows that downtime rates higher than 15% should be avoided.

A central source of information on maintenance equipment would be provided by implementing an equipment management system. A June 1978 study, Equipment Management System, prepared by the United States Department of Transportation, provides management guidelines for replacing and repairing equipment. The primary objective of this system is to obtain maximum productivity from equipment and equipment supporting resources. This objective is achieved by knowing the costs required to own, maintain, and operate an equipment unit. This system can provide for the most effective management of equipment expenditures.

All relevant cost items are considered with the equipment management system, in order to reduce the costs of a maintenance fleet to the lowest possible level. There is a point when the costs of maintenance and ownership are at a minimum. As the ownership cost, original purchase or replacement price (less its resale value), is spread over the number of hours or miles the unit has been in use, the ownership cost per hour or mile decreases. As for maintenance costs, an opposite effect occurs. The maintenance costs, which include direct labor and parts, increase the longer the equipment unit is in use. The following graph illustrates this concept.



Source: Equipment Management System, A June 1978 Study by the U. S. Department of Transportation.

Costs are highest when a unit is replaced before it reaches its lowest level of ownership and maintenance costs. On the other hand, when a unit is kept beyond the point of minimum costs, the costs of ownership and maintenance generally rise. Consequently, the optimal point for replacing an equipment unit is when its total costs per hour or mile are at a minimum.

One of the contributing factors of high downtime on equipment is the inability to find spare parts for old machines. This can be attributed to equipment bought on a low bid basis without guaranteed supply

of parts. A similar conclusion was reached by the Kansas Legislative Division of Post Audit in its January 1979 report, Maintaining Kansas Highways. Kansas found that its Highway Department had equipment in repair much longer than recommended because of an inability to find spare parts for old machines. Kansas also learned that this is a major problem for most states and is caused primarily by buying equipment on a low bid basis without guaranteed supply of parts. The Kansas auditors concluded that requiring bids on the life of the equipment, or that the bidder stock parts for the life of the equipment, were ways to solve this problem.

In FY 79-80, the Department spent \$3,297,080 on equipment purchases and \$3,129,760 on equipment repairs. Table 18 shows equipment purchases and repair costs for four fiscal years.

TABLE 18
EQUIPMENT PURCHASES AND REPAIR COSTS FOR THE
SOUTH CAROLINA HIGHWAY DEPARTMENT FOR
FISCAL YEARS 1976-1980

<u>Fiscal Year</u>	<u>Equipment Purchases</u>	<u>Equipment Repairs</u>
1979-80	\$3,297,080	\$3,129,760
1978-79	3,704,453	2,829,654
1977-78	2,477,938	2,532,205
1976-77	1,214,386	2,014,200

An alternative to the present system of purchasing is the total cost bidding technique. Total cost bidding provides an ownership

package which includes guaranteed maintenance and a guaranteed minimum cash repurchase price in addition to the normal original machine cost and guarantees. Investments are protected with total cost bidding because the dealer guarantees service and maintenance. A distinction between initial price and total price can be made with total cost bidding, therefore, equipment is purchased at the lowest total price rather than the lowest initial price.

In FY 79-80, SCDHPT spent almost the same amount on repairs, \$3,129,760, as it spent on equipment purchases, \$3,297,080. Repair costs are not only high but time-consuming. A downtime of 19.5% means that equipment is idle one out of five working days due to repairs. Equipment breakdowns and unavailability decrease the efficiency with which highway maintenance plans are executed and result in higher costs. Delays, and the need to reschedule maintenance work that results from equipment breakdown, means less than full utilization of maintenance manpower.

RECOMMENDATIONS

THE DEPARTMENT SHOULD IMPLEMENT AN EQUIPMENT MANAGEMENT SYSTEM, A SYSTEM GEARED TOWARDS OBTAINING MAXIMUM PRODUCTIVITY FROM EQUIPMENT AND EQUIPMENT SUPPORTING RESOURCES. THIS WOULD ESTABLISH A SYSTEMATIC APPROACH FOR EQUIPMENT BUDGETING AND REPLACEMENT.

THE DEPARTMENT SHOULD FORM A TASK FORCE
TO STUDY THE TOTAL COST BIDDING TECHNIQUE
FOR PURCHASING EQUIPMENT AND AS A METHOD
TO REDUCE REPAIR COSTS.

Roads and Drives of State Facilities Funded by Highway Department

The South Carolina Department of Highways and Public Transportation is constructing and maintaining roads and driveways for State parks and State institutions at no cost to the parks or institutions. The projects are funded by the State Highway Department from the State Motor Fuel Tax. The expenditures are shown in the State highway budget, resulting in understating the costs of State parks and institutions. From FY 77-78 to FY 79-80, the Department spent \$978,991 constructing and maintaining streets, roads, and driveways for State facilities.

An allocation is made yearly for the construction and maintenance of roads and drives for parks and institutions. The amount of the allocation is determined by the Chief Highway Commissioner with the approval of the State Highway Commission. For the FY 80-81, \$400,000 has been allocated for State parks and institutions.

Projects are requested by the Department of Parks, Recreation and Tourism and by other State agencies. These are then evaluated and selected by the Chief Highway Commissioner, State Highway Engineer, and Highway Commission.

The streets, roads, and driveways of State parks and institutions are constructed and maintained in accordance with South Carolina Codes, Sections 57-3-640 and 57-3-660 which state:

The Department may construct and maintain necessary driveways and roads in State parks. All work to be performed by the Department pursuant to the provisions of this section shall be with the consent and approval of the Department of Parks, Recreation and Tourism, and such work shall not result in the assumption by the Department of any liability whatsoever on account of damages to property, injuries to persons or death growing out of or in any way connected with such work. Such driveways and roads taken over in State parks shall not affect the respective counties' portion of mileage to be taken over by the Department under any other statute. The construction and maintenance work by the Department authorized by this section shall be paid for from the State highway fund. [Emphasis Added]

The Department may hard surface and otherwise improve such streets, roads and driveways, including sidewalks, at State institutions as the Department, together with the board of trustees or other governing body of any such State institution, may deem necessary. The cost of such improvements shall be paid for out of the State highway fund. [Emphasis Added]

•The law directs the Highway Department to construct and maintain streets, roads, and driveways of State parks and institutions. They are paid for by the State highway fund at no charge to the park or institution.

To learn how other states handle construction and maintenance of state parks and institutions, the Audit Council surveyed nine other southeastern states: Alabama, Florida, Georgia, Kentucky, Louisiana, North Carolina, Mississippi, Tennessee, and Virginia. No state in the survey constructs or maintains all the roads and driveways of state facilities free of charge.

Two of the state highway departments in the survey (Louisiana and Virginia) pay for some of the park and institution roads because they have included these roads in the state highway system. Roads not in the state system and driveways are the responsibility of the park or institution.

The seven other states (Alabama, Florida, Georgia, Kentucky, North Carolina, Mississippi, and Tennessee) do not render free services. If one of the highway departments in these states accepts a project, whether they contract it to a private firm or perform the work themselves, the park or institution which benefits reimburses the highway department for the cost. These states include appropriations for streets, roads, and driveways in their state park or state institution budgets.

Since the construction and maintenance of roads and drives for State parks and institutions in South Carolina are funded by the Highway Department, the actual cost for these State facilities are not reflected in their budgets. The expenditures are shown in the State highway budget, resulting in understating the cost of State parks and institutions.

Act 651 of 1978 requires that State agencies present budgets in such a manner to show all costs:

The Board shall revise the structure of the annual State budget so as to present a format which clearly delineates each agency's and institution's programs, their sources of revenue, and the total program costs.
[Emphasis Added]

Effective decision-making would require that all costs of a program in an agency be known, otherwise, decisions are based on incomplete information.

In addition, the present method requires State agencies to justify their paving needs only to the Highway Department. These requests are thus placed outside of the normal budgeting process and State agencies are not required to justify and set priorities for their capital improvements to the House and Senate appropriations committees and the General Assembly. In order to ensure that only requests yielding maximum benefits are funded, paving projects should compete with other program needs for State funds.

For the past three years, the Department has spent \$978,991 on State parks and institutions, an average of \$326,330 a year. From its sample of resurfacing contracts, the Audit Council found that it cost an average of \$20,384 per mile in 1980 to resurface a road in South Carolina (see p. 24). If the Department spent the yearly average of \$326,330 it spends on State parks and institutions for resurfacing, 16 additional miles of State roads could be resurfaced each year.

RECOMMENDATIONS

THE DEPARTMENT SHOULD DISCONTINUE ITS PROGRAM OF CONSTRUCTING AND MAINTAINING ROADS AND DRIVEWAYS FOR STATE PARKS AND INSTITUTIONS FREE OF CHARGE.

PARKS OR INSTITUTIONS SHOULD BE RESPONSIBLE FOR THE CONSTRUCTION AND MAINTENANCE OF THEIR ROADS AND DRIVES UNLESS THE ROADS ARE INCLUDED IN THE STATE HIGHWAY SYSTEM.

PARKS OR INSTITUTIONS SHOULD PRESENT THEIR REQUEST AND JUSTIFICATION FOR ROAD CONSTRUCTION AND MAINTENANCE AS PART OF THEIR ANNUAL BUDGET REQUESTS.

APPENDICES

APPENDIX A

THURSDAY, JANUARY 10, 1980

CONCURRENT RESOLUTION

The following was introduced:

H. 3288.—Reps. McTEER, KLAPMAN, DUKES, BRANTON, HINSON, NUNNERY, O. PHILLIPS, RIGDON, OGBURN, W. ARTHUR, DUNCAN, BEASLEY, DANGERFIELD, P. BRADLEY, J. T. WOOD, BARKSDALE, KIRSH, LEE, SCHWARTZ, MARTIN, BUSBEE, J. M. ARTHUR, J. HARRIS, HARVIN, JAMES KINARD, HEARN, HARDY, TOAL, CARNELL, HODGES, MEYERS, J. MURRAY, HOLT, BRINKER, WINSTEAD, R. WOODS and GULLEDGE: A Concurrent Resolution to direct the Legislative Audit Council to investigate the rapidly increasing cost of road paving to determine if alternative methods or practices can be utilized to reduce the increasing cost of paving in the future.

Whereas, the cost of highway paving has increased more rapidly than the present rate of inflation; and

Whereas, the bidding process, materials used and other relevant factors in the process of paving the state's highways should

be investigated to determine if paving costs in the future can be reduced. *Now, therefore*,

Be it resolved by the House of Representatives, the Senate concurring:

That the Legislative Audit Council is directed to investigate the rapidly increasing cost of road paving to determine if alternative methods or practices can be utilized to reduce the increasing cost of paving in the future and make a report to the General Assembly with recommendations before the end of the 1980 session of the General Assembly.

The Concurrent Resolution was agreed to and ordered sent to the Senate.

APPENDIX B

STATEWIDE RESURFACING NEEDS BY COUNTY AS OF JULY 1980

<u>County</u>	<u>Number of Miles</u>	<u>County</u>	<u>Number of Miles</u>
Abbeville	11.80	Jasper	26.90
Aiken	160.23	Kershaw	153.90
Allendale	20.90	Lancaster	229.55
Anderson	146.95	Laurens	64.55
Bamberg	21.30	Lee	90.75
Barnwell	13.60	Lexington	78.15
Beaufort	22.69	McCormick	67.92
Berkeley	59.57	Marion	82.16
Calhoun	6.70	Marlboro	188.80
Charleston	35.15	Newberry	107.00
Cherokee	112.69	Oconee	183.00
Chester	248.85	Orangeburg	34.00
Chesterfield	212.40	Pickens	164.50
Clarendon	103.60	Richland	141.11
Colleton	30.85	Saluda	179.10
Darlington	75.65	Spartanburg	387.10
Dillon	159.62	Sumter	92.40
Dorchester	36.05	Union	81.36
Edgefield	42.50	Williamsburg	226.20
Fairfield	141.25	York	330.93
Florence	337.05		
Georgetown	235.44	State Total	5,726.84
Greenville	219.50		
Greenwood	106.93		
Hampton	34.00		
Horry	222.19		

APPENDIX C

PERCENTAGE TOTALS OF COST CATEGORIES FOR 50
STATE C-FUNDED SECONDARY ROAD PROJECTS 1970-1980¹

	<u>Year</u>				
	<u>1971</u>	<u>1973</u>	<u>1975</u>	<u>1977</u>	<u>1979</u>
Number of Projects:	10	10	10	10	10
Total Mileage:	56.479	44.300	37.921	40.027	27.427
<u>Cost Categories by Percent of Total Cost</u>					
Clearing & Grubbing:	10.8%	12.0%	13.1%	11.7%	10.6%
Surface Preparation:	50.0	35.1	41.1	42.6	32.3
Paving:	19.1	30.3	24.1	25.6	28.7
Equipment & Materials:	16.7	15.4	16.4	12.1	22.0
Other:	<u>3.4</u>	<u>7.2</u>	<u>5.3</u>	<u>8.0</u>	<u>6.4</u>
TOTAL	100%	100%	100%	100%	100%

¹See Table 4 for dollar cost per category.

APPENDIX C (CONTINUED)

PERCENTAGE TOTALS OF COST CATEGORIES FOR 46
STATE A-FUNDED PRIMARY ROAD PROJECTS 1970-1980¹

	<u>Year</u>				
	<u>1971</u>	<u>1973</u>	<u>1975</u>	<u>1977</u>	<u>1979</u>
Number of Projects:	8	8	10	10	10
Total Mileage:	12.535	26.698	13.736	19.471	11.150
<u>Cost Categories by Percent of Total Cost</u>					
Clearing & Grubbing:	7.8%	9.3%	7.1%	6.7%	5.8%
Surface Preparation:	39.5	30.2	25.4	20.0	19.0
Paving:	22.4	38.0	37.3	38.8	41.1
Structures:	6.0	2.7	1.8	6.6	5.3
Equipment & Materials:	9.8	9.8	13.2	11.7	15.3
Masonry:	1.0	-0-	1.2	1.5	0.5
Other:	<u>13.5</u>	<u>10.0</u>	<u>14.0</u>	<u>14.7</u>	<u>13.2</u>
TOTAL	100%	100%	100%	100%	100%

¹See Table 5 for dollar cost per category.

APPENDIX C (CONTINUED)

PERCENTAGE TOTALS OF COST CATEGORIES FOR 44

STATE RESURFACING PROJECTS 1970-1980

	<u>Year</u>				
	<u>1971</u>	<u>1973</u>	<u>1975</u>	<u>1977</u>	<u>1979</u>
Number of Projects:	10	10	6	8	10
Total Mileage:	255.737	151.118	57.718	151.497	80.419
<u>Cost Categories by Percent of Total Cost</u>					
Sand Asphalt:	1.0%	2.0%	1.0%	17.0%	25.0%
Asphalt Concrete:	78.0	73.0	69.0	49.0	36.0
Asphalt Cement:	21.0	23.0	30.0	34.0	39.0
Other:	<u>-0-</u>	<u>2.0</u>	<u>-0-</u>	<u>-0-</u>	<u>-0-</u>
TOTAL	100%	100%	100%	100%	100%

APPENDIX D



SOUTH CAROLINA

DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

P.O. BOX 191
COLUMBIA, S.C. 29202

April 10, 1981

Mr. George L. Schroeder
Director
Legislative Audit Council
620 Bankers Trust Tower
Columbia, South Carolina 29201

Dear Mr. Schroeder:

Attached are our written comments to be included as an attachment to the report of the audit of the S. C. Department of Highways and Public Transportation prepared by the Legislative Audit Council.

It is the desire of the Department to have these comments made a part of the final report. Your cooperation is appreciated.

Yours very truly,

A handwritten signature in cursive script that reads "Paul W. Cobb".

Paul W. Cobb
Chief Commissioner

APPENDIX D (CONTINUED)

Chapter III - Need to Implement a Maintenance Management System

Comments

The following comments by the South Carolina Department of Highways and Public Transportation are intended to convey an explanation of how the Department's maintenance program is administered.

A. Management Methods

The Department does not have a sophisticated, computerized Highway Maintenance Management System (MMS) but does have a strong management team in our District Engineering setup and our county maintenance units. Each of the seven (7) Engineering Districts are managed by a District Engineering Administrator and is assisted by a District Maintenance Engineer and one or more District Construction Engineer, and a District Mechanical Engineer. Management methods used by this team are direct contacts with the county units on a weekly basis and the "Maintenance by Objective" concept that is time tested and has proven to be workable, economical and efficient. A recent study (Analysis of State Maintenance Operations in the United States prepared by the New York State Division of the Budget, Transportation and Economic Affairs Unit, State Capitol, Albany, New York, 12224) showed that 27 states which had implemented formal Highway Maintenance Management Systems (HMMS) had average expenditures 2.5 percent below projected. South Carolina in this study had 40.5 percent below projected expenditures. Further, South Carolina was the lowest of the fifty states in expenditure per lane mile (\$534) in this same study.

The county units are generally situated in the county seat of government and due to geographic conditions may contain one or more "Satellite" or Section Shed Locations in remote areas of the county to more efficiently manage the road mileage in a particular area. The County Maintenance Unit is managed by a Resident Maintenance Engineer and in the larger counties he is assisted by an Assistant Resident Maintenance Engineer. This management team is supplemented by a number of Highway Maintenance Crew Supervisors (Foreman) who are in direct charge of the work crews. Each county unit is allotted the authority to use these resources to the best advantage for the maintaining of the roads in his area in accordance with the previous given verbal instructions, Performance Standards, Policy and Procedure Memorandum, Maintenance Memorandums and general memorandums.

B. Follow Up

There is continual follow-up on work performed by each level of the Hierarchy by means of inspections, staff meetings, correspondence, reports and internal and external audits. Each District Maintenance Engineer visits with each of the county Resident Maintenance Engineers on a systematic schedule, inspects the overall maintenance of the roads in that particular county and also goes over any problem areas that the Maintenance Engineer might have.

The State Maintenance Engineer and his assistants monitor the incoming field reports and periodically schedule field trips to verify that the reported conditions are the same as the actual field conditions. These field trips are made in company with the District Engineering Administrator or his assistant so that this level of management is always informed as to the problem areas and the level of service desired by the Central Office and to insure that

APPENDIX D (CONTINUED)

Chapter III - Need to Implement a Maintenance Management System, cont'd.

the condition of the Interstate Routes as well as the remaining system is maintained at the level required by the purposes for which they were designed.

1. In a recent study "Analysis of State Maintenance Operations in The United States" prepared by the New York State Division of the Budget; Transportation and Economic Affairs Unit; State Capitol, Albany, New York dated June 1978 states the following conclusion:

"The 27 states which had implemented Highway Maintenance Management Systems had average expenditures 2.5 percent below projected. This might indicate that such systems could be marginally beneficial in reducing costs". (Emphasis added.)

2. The bottomline in a sophisticated computerized management system is the accurate reporting of every aspect of the job performed and this information must, of necessity, be supplied by the lowest level of supervision.

3. As opposed to the above, the Management by Objective method relies on engineering judgement, available resources, and actual field conditions as seen by a trained observer.

4. It is this writer's opinion that the implementation of a Sophisticated Computerized Maintenance Management System does not necessarily result in better maintenance or reduced costs.

Chapter III - Weight Enforcement Program is Inadequate

Comments

The following comments by the S. C. Department of Highways and Public Transportation are intended to convey an explanation of how the Department's Weight Enforcement Program is administered.

South Carolina presently has a total of twenty-seven enforcement officers, all commissioned highway patrolmen, assigned to the Weight Enforcement Program. This unit includes one (1) Captain, two (2) Lieutenants, and twenty-four (24) other patrolmen. The unit is also provided necessary clerical and administrative support. This is reported by LAC to be the smallest number of enforcement personnel in the Southeastern United States. It should be noted that South Carolina is one of the smallest states in this region and based on recent required reports to the Federal Highway Administration this program has been approved as adequate for South Carolina truck size and weight enforcement. In fiscal year 1980 there were 395,957 trucks checked and 17,634 cases made with fines of \$622,976. The enforcement is admittedly on a sampling basis. The statistics quoted for number of enforcement personnel per mile of state highway are not significant since truck traffic in the main is confined to about twelve to fifteen arterial routes through the state. Enforcement of weight and size on the secondary system is required only in special situations.

APPENDIX D (CONTINUED)

Effective June 11, 1980, the Department has been authorized to collect civil penalties for weight violations. During the period from that date through January '81 this has been credited in the amount of \$94,976.38. Fines under South Carolina law provide for a maximum of \$100 for each violation and this is discretionary with magistrates. This scale is among the lowest in the United States. The average fine in fiscal year '80 was less than \$40. With reference to the LAC comment concerning fines, this is a function of the law and its application by the judicial system over which the Department has no control. It is agreed that significant penalties would be a deterrent.

Chapter III - Equipment Program is Inefficient

Comments

The following comments by the S. C. Department of Highways and Public Transportation are intended to convey an explanation of how the Department's Equipment Management Program is administered.

The Department operates repair shops in each county maintenance unit close to point of operation and these shops are managed by experienced supervisors who are dedicated to quality work at the lowest cost. They are guided in the priority of equipment repair by the maintenance supervisor who is the user and knows that equipment which is most needed by his maintenance operation. The LAC report indicates that equipment downtime is 19.5%. There is no way that this information needed to obtain this figure can be verified from Department records, in a statistically valid way. Mechanical Engineers with the Department, from their experience, believe this to be too high a percentage. This would mean each piece of equipment being down one day a week and this is not the case.

The LAC report attributes downtime to be the result of buying equipment on a "low bid basis" without a parts guarantee in the specifications.

The Department does not have any problem, in obtaining parts, that is not experienced by private business. The lack of availability of parts is due to the reluctance of the parts houses to tie up considerable sums in large inventories. This, of course, is attributed to the high interest rate and the general status of our economy.

The Supply and Equipment Office writes specifications which have the objective of obtaining the best equipment that the Department can afford on the competitive basis required by law based on actual needs of our equipment users. The specifications are written with initial purchase costs and long-run operating costs in consideration. Downtime is not related to any measurable extent from equipment specifications. Purchasing equipment with a guaranteed parts availability would increase markedly the initial equipment price, and also increases parts costs since many parts now purchased by the Department come from independent parts sources at great savings.

The only factor which can consistently be correlated to equipment downtime, as a generalization, is age. The Department has allocated the amount of money to equipment that is allowable within its resources. Equipment is replaced as recommended by the ones in the field who are close to its use.

APPENDIX D (CONTINUED)

Additional statistical information would not be of value unless more money is available for equipment. Instituting an Equipment Management System will require more computer equipment and additional people to accumulate the information. At present any additional money would be better spent on equipment that is obviously needed. The Department feels that this would be a "trade-off" between a system and needed equipment.

Chapter III - Providing Access Driveways to Private Property

Comments

The following comments by the South Carolina Department of Highways and Public Transportation are intended to explain the Department's Driveway Paving Policy.

In FY 77-78 and 79-80 due to public demand, a program was implemented to pave numerous driveways throughout the State that had not been previously paved. We feel that the cost is distorted during these years due to the acceleration of this program, and the figures included in the LAC report are not representative of a normal year.

Over the years, the Department has paved driveways to the right of way line when the road was originally constructed. When the roads were accepted for maintenance and a new driveway requested, SCDHPT installed the drive, placing dirt and sometimes gravel to stabilize. If, due to grade or other physical characteristics, the driveway as installed became a problem, the Department would pave the driveway to the right of way line to decrease the cost of maintenance. A side benefit to the paving of these driveways was the reduction of damage claims due to low shoulders which were common at the edge of the travelway where ingress and egress was made to private property. Paved driveways also tend to reduce accidents since they provide smooth, unimpeded movement of vehicles from the traffic flow into adjacent land use areas.

GLOSSARY OF TERMS

- Aggregate - Any hard, inert, mineral material used for mixing in graduated fragments. It includes sand, gravel, crushed stone and slag.
- Asphalt Cement - Asphalt that is refined to meet specifications for paving, industrial and special purposes.
- Asphalt Concrete - High quality, thoroughly controlled hot mixture of asphalt cement and well graded, high quality aggregate thoroughly compacted into a uniform dense mass.
- Asphalt Emulsion - An emulsion of asphalt cement and water which contains a small amount of an emulsifying agent, a heterogeneous system containing two normally immiscible phases (asphalt and water) in which the water forms the continuous phase of the emulsion, and minute globules of asphalt form the discontinuous phase.
- Bituminous Surfacing - A wearing surface of two or more applications of liquid asphalt and two or more applications of crushed aggregates. Also known as "tar and gravel" roads.
- Interstate Road System - Connects, as directly as practicable, the nation's principal metropolitan areas, cities, and industrial centers; serves the national defense and connects at suitable border points with routes of continental importance.
- Primary Road System - Connects centers of population as determined by the State Highway Commission and will not exceed 10,000 miles.
- Resurfacing - Consists of one or more leveling courses of asphalt concrete to establish proper gradient and cross-section over an old or worn out road. An intermediate and surface course of asphalt concrete is then placed over the leveling course. The total thickness of the asphalt used for resurfacing is determined by the road strength needed to handle traffic loads and volume.
- Secondary Road System - Comprised of feeder roads linking farms, distribution outlets and smaller communities with the Primary System.