BY THE COMPTROLLER GENERAL

Report To The Congress

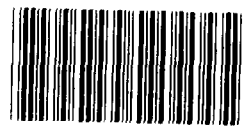
OF THE UNITED STATES

Solving Corrosion Problems Of Bridge Surfaces Could Save Billions

Bridge surfaces which were expected to last for 40 years are requiring major repairs after 5 to 10 years, and often must be replaced after 15 years. Preventing this deterioration, which is caused by salt used to melt snow, would save the Department of Transportation billions of dollars in repair costs.

Cost-effective systems are available to protect newer bridges that are not yet contaminated by the salt--they should be installed quickly.

For bridges which are contaminated but not badly deteriorated, a cost-effective method of stopping further deterioration is needed.



PSAD-79-10
JANUARY 19, 1979

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-164497(3)

To the President of the Senate and the
Speaker of the House of Representatives

Premature deterioration of concrete bridge decks in the Nation's Federal-aid highway systems is a major problem. The deterioration is caused by the corrosion of the reinforcing steel bars in the bridge deck, brought about by the chloride deicing chemicals used in winter.

This report describes the need (1) to protect bridge decks with only slight contamination now and (2) to find an effective method for stopping further deterioration of heavily contaminated bridge decks. Preventing or stopping further deterioration would save billions of dollars by avoiding premature replacement of the bridge decks.

We are sending copies of this report to the Director, Office of Management and Budget, and the Secretary of Transportation.

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

SOLVING CORROSION PROBLEMS OF BRIDGE SURFACES COULD SAVE BILLIONS

D I G E S T

Although bridge roadway surfaces (decks) were expected to provide relatively maintenance-free service for about 40 years, the Federal Highway Administration has found that some unprotected bridge decks require major repair within 5 to 10 years, and often must be replaced after 15 years of service. The major cause of this early deterioration is corrosion of the reinforcing steel bars in the bridge deck, brought about by chloride chemicals which are used to melt snow. (See ch. 1.)

About $6.3 billion is needed to restore the Nation's Federal-aid system bridge decks. GAO's survey of the 50 States and the District of Columbia identified 32 States with 162,622 Federal-aid system bridges having a moderate to very major bridge deck problem.

Most States have indicated that, if present conditions are not improved, their currently repairable bridge decks will continue to deteriorate, and eventually require complete replacement at a much higher cost. For example, a Federal Highway Administration report points out that, if 29,000 interstate bridge decks continue to be neglected, an additional $4.4 billion will be needed later to repair these bridge decks. (See ch. 2.)

SLIGHTLY CONTAMINATED BRIDGE DECKS

A number of bridges in the Federal-aid system do not have a protective system on their decks. They contain either no areas or only small areas where chloride levels are high enough to cause bridge deck deterioration. If these bridge decks were protected with one of the systems now used for new bridge construction, significant savings could be realized by avoiding more expensive repairs

later. The potential benefit/cost ratio of repairing and protecting an existing bridge deck needing only minor repair versus completely replacing the deck at a later date is 2.75 to 1.

Lack of funds is the primary reason that States have not installed protective systems on existing bridges.

State officials GAO contacted indicated that funds available for bridge repair are generally budgeted for bridges so deteriorated that replacement of the deck is the only option. As a result, those bridge decks with little or no deterioration will continue to deteriorate, and eventually require repairs or replacements that are much more costly than the cost of the protective systems. (See ch. 3.)

GAO recommends that the Secretary of Transportation identify those bridge decks which can be economically restored, estimate the cost of restoring them, and develop a plan for repairing these decks as soon as possible.

HEAVILY CONTAMINATED BRIDGE DECKS

Many of the existing unprotected bridge decks in 32 States contain chloride levels above the corrosion threshold which will cause the bridge deck to deteriorate, and eventually to require replacement, unless a means is found to halt the deterioration. Numerous techniques are being investigated which may protect these bridge decks from further deterioration. However, the Federal Highway Administration has not yet developed proven, cost-effective techniques for stopping the deterioration.

Cost-effective solutions are needed quickly to avoid using billions of dollars for complete replacement of the bridge decks. (See ch. 4.)

GAO recommends that the Secretary of Transportation reassess the progress being made in finding proven, cost-effective methods for protecting existing chloride-contaminated bridge decks, and take appropriate action to resolve any problems that are delaying progress.

LONG-TERM EVALUATION PROCEDURES NEEDED

Weaknesses also exist in the Federal Highway Administration's evaluation process to assess the performance of the technologies in extending the service life of the bridge decks. For example, the Federal Highway Administration lacks a formal system to monitor and evaluate the long-term performance of protective systems which were approved for nationwide use on the basis of laboratory and short-term field performance data. (See ch. 5.)

To improve the technology evaluation process, GAO recommends that the Secretary of Transportation establish a formal long-term data collection and evaluation system for bridge deck protective systems.

AGENCY COMMENTS

The Department of Transportation agreed that GAO had accurately assessed the bridge deck problem and concurred with GAO's recommendations. In several cases, it has begun to make the changes necessary to carry out GAO's recommendations. For example, the Federal Highway Administration:

--Will modify its data retrieval program to better identify bridge deck conditions which will enable more realistic cost estimates of bridge repairs. This program is scheduled to begin in fiscal year 1980. Federal Highway Administration officials also said that the Surface Transportation Act of 1978 now authorizes adequate Federal funds for bridge replacement and rehabilitation on an 80-20 ratio, but that the States remained faced with the problem of providing matching funds.

--Plans to propose a new federally coordinated research and development project in fiscal year 1980 to search for a less expensive rehabilitation procedure which does not involve the removal of large quantities of concrete.

--Will institute in fiscal year 1979 a program to provide a long-term data collection system for protective systems. (See app. II.)

The Federal Highway Administration provided other more detailed comments that GAO included in the body of the report where appropriate.

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CHAPTER 1

INTRODUCTION

The Federal-aid highway system contains over 235,700 bridges. The deterioration of an ever increasing number of the bridge roadway surfaces (decks) is a major and still growing problem facing State and Federal governments. The Federal Highway Administration--the agency responsible for the Federal-aid highway system--estimates that $6.3 billion is required to restore the surfaces on Federal-aid system bridges, of which $1.7 billion is for Interstate system bridge decks.

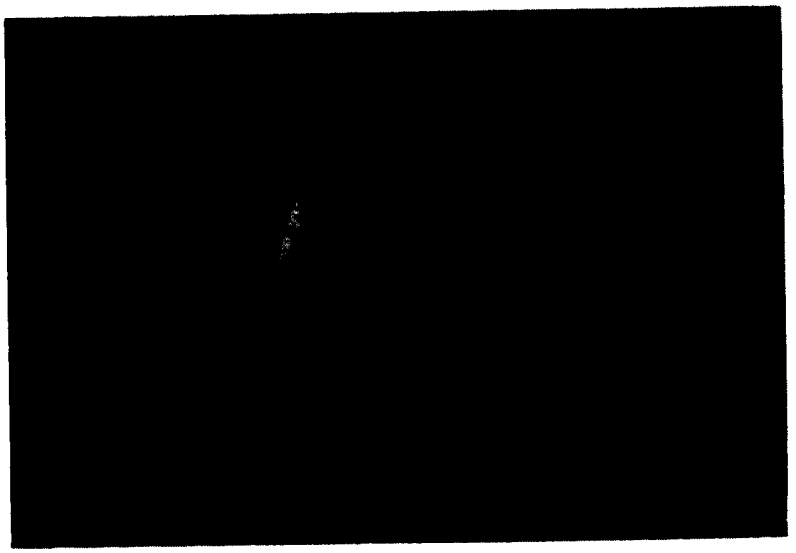
This problem originated in the mid-1950s when highway departments adopted a "clear pavements" policy of heavily salting roadway surfaces to improve winter traffic conditions. With repeated applications, the chlorides penetrate the concrete surface, and eventually reach the reinforcing steel. Corrosion of the steel will occur when the chloride interacts with the moisture and oxygen in the concrete. Because the rusted steel occupies much more space, pressure is exerted on the concrete, and eventually potholes develop. (See fig. 1.)

Since the late 1950s, highway officials have become increasingly concerned about the growing number of prematurely deteriorated concrete bridge decks. Bridge decks are intended to provide relatively maintenance-free service for about 40 years. However, the Federal Highway Administration found that unprotected bridge decks receiving deicing chemicals require major repair within 5 to 10 years, and often must be replaced after only 15 years of service.

As a result, in the late 1960s, the American Association of State Highway and Transportation officials requested the Transportation Research Board of the National Academy of Sciences to prepare a state-of-the-art report on the concrete bridge deck deterioration problem. This report, issued in 1970, summarized earlier research study efforts which identified corrosion of the reinforcing steel as the primary cause of bridge deck deterioration.

RESEARCH PROGRAM OVERVIEW

The Federal Highway Administration's research and development program encompasses varied activities designed to achieve solutions to the urgent highway system problems.



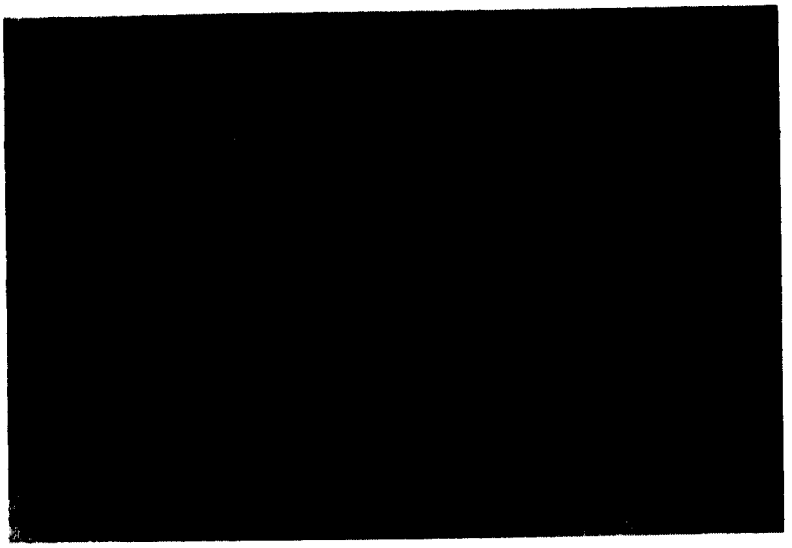


FIGURE 1

VIEWS OF BRIDGE DECK DETERIORATION

In July 1971, the Federal Highway Administration began a major research effort to develop solutions for the bridge deck problem with the initiation of an in-house laboratory testing program. The objective of this program was to determine the relative time-to-corrosion of reinforcing steel embedded in concrete slabs fabricated with various concrete mixes, construction techniques, and special additives. The intent here was to evaluate the majority of solutions then being suggested as methods of reducing the chloride permeability of concrete.

The study showed that certain techniques were not effective in limiting chloride intrusion, and that even excellent quality concrete (similar to that used in typical field construction) provided little protection against corrosion. Hence, it was concluded that special techniques were required to prevent early deterioriation of bridge decks. The study further demonstrated that application of certain techniques could significantly limit the intrusion of chlorides even after hundreds of daily salt applications. For example, research has been successful in developing several methods for protecting new bridges. These include:

--Membrane systems with asphalt overlays. Five systems, four sheet-type and one liquid-type, have been designated as acceptable items for new construction. These systems are intended to seal the concrete against chloride intrusion.

--Epoxy-coated reinforcing steel bars. The epoxy coating protects the reinforcing steel bars from the chlorides, moisture and oxygen; thus, corrosion is prevented.

--Low water-cement ratio, dense concrete overlay system and the latex modified concrete overlay system. These special concretes slow the penetration of chlorides into the concrete, preventing critical levels of chlorides from reaching the reinforcing steel, thus, corrosion is prevented.

--Internally sealed concrete using wax beads. Federal Highway Administration officials told us that this is a promising new technique.

In May 1974, the Federal Highway Administration issued a notice to its field offices adopting several membrane systems as "nonexperimental" items for new construction. In March 1976, the epoxy-coated reinforcing bars and the two

concrete overlay systems were also adopted as "nonexperimental" items for new construction. For States to qualify for Federal aid, the Federal Highway Administration now requires them to apply a protective system when constructing new bridge decks likely to receive deicing salt applications.

Early research also focused on developing techniques to determine the condition of existing bridge decks. In February 1974, the Federal Highway Administration's report stated that the only way to be assured of permanent repair was to remove all concrete in a potentially destructive condition, and then prevent future deicing salts from reaching the reinforcing steel. Bridge decks in a potentially destructive condition were defined as those containing a specified level of chlorides, referred to as the "corrosion threshold."

The Federal Highway Administration recognized that the removal of the contaminated concrete might not be feasible because of the high cost. Therefore, research also pursued the development of technologies which could stop the deterioration of decks without having to remove the contaminated concrete. The Federal Highway Administration supported the development and evaluation of technologies to neutralize the effect of the chlorides in the concrete. Research was primarily directed toward controlling the chlorides, rather than the other factors required to support corrosion, such as moisture and oxygen, because this was deemed the more feasible approach.

Pending development of these technologies, the Federal Highway Administration in April 1976 authorized an experimental procedure to protect bridge decks. This procedure is to place one of the membrane or overlay systems used for new construction over chloride contaminated decks.

Concerning the overall research program, Federal Highway officials, in responding to our report, said that since the late 1960s the program has been outstanding in the efforts to identify the causes of deterioration and has provided research leadership in the field of corrosion in concrete.

Because of the large potential saving of protecting, rather than replacing, the current inventory of structurally sound bridge decks, we reviewed the progress being made in applying protective systems to these existing bridges and the cost effectiveness of these measures. Chapter 2 discusses the current magnitude of the bridge corrosion problem. Chapter 3 discusses those decks containing levels of chloride below the level at which active corrosion of the

reinforcing bars begins. Chapter 4 discusses bridge decks which are heavily contaminated with chloride where active corrosion has begun. Chapter 5 discusses the need to provide long-term data feedback to validate the performance of the protective systems.

CHAPTER 2

CURRENT MAGNITUDE OF BRIDGE CORROSION PROBLEM

To determine the magnitude and extent of the bridge deck corrosion problem, we developed a questionnaire on the subject which was sent to all 50 States and the District of Columbia. The questionnaire requested information in the following areas:

--The extent of the bridge deck deterioration problem.

--The extent to which the States have applied the protective systems to the Federal-aid system bridge decks.

--The conditions limiting their application.

--The backlog of bridge decks requiring partial or complete reconstruction.

--The potential effect of the problem if not addressed and corrected.

We received 49 usable responses providing information on the Federal-aid system bridges. This data is summarized below.

RESULTS OF OUR SURVEY

The 49 States 1/ reported having over 235,700 Federal-aid system bridges. Seventeen of these States with over 73,000 bridges indicated that the bridge deck situation was only a minor problem. The remaining 32 States, however, categorized their deck problem as moderate to very major. (See app. I.) These 32 States contain over 160,000 Federal-aid system bridges. (See table 1.)

1/This includes the District of Columbia, which we refer to as a State in this report for convenience. New Hampshire and Washington did not provide usable responses.

Table 1

Magnitude of bridge deterioration	Number of States reporting	Number of bridges reported
None or minor	17	73,154
Moderate to very major	32	162,622
Total	49	235,776

Little progress has been made by the States in protecting the Federal-aid system bridge decks against premature deterioriation due to corrosion of the reinforcing steel. (See table 2.) For example, 23 of the 32 States with a serious deterioration problem responded that less than 10 percent of their bridge decks have been restored and/or protected against future salt applications. Little improvement can be expected in the future as shown below in table 2.

Table 2

Percentage of bridge decks with protective systems	1977 situation (No. of States)	1980 situation (No. of States)
0 - 10	23	9
11 - 20	6	15
21 - 30	1	2
31 - 40	1	1
41 - 50	-	-
over 50	1	5
Total	32	32

IMPLICATIONS OF SITUATION

Twenty-seven of the 32 States reported that, unless repairs are completed in the next 3 to 5 years, their currently salvageable bridge decks will deteriorate to the point of requiring complete replacement. This results in greatly increased repair costs. For example, a Federal Highway Administration study indicated that, if the 29,000 interstate bridge decks requiring minor repair today were neglected to the extent that they require moderate repair, the current repair cost of about $600 million would increase by an additional $4.4 billion. These estimates are in 1975 dollars.

CHAPTER 3

BRIDGES WITH ONLY SLIGHT CONTAMINATION

NEED TO BE PROTECTED NOW

There are a number of bridges in the Federal-aid system with little or no chloride contamination of the decks. If these bridge decks were protected with one of the systems now used for new bridge construction, significant savings could be realized by avoiding more expensive repairs later.

The potential benefit/cost ratio of repairing and protecting an existing bridge deck requiring only minor repair versus completely replacing the deck at a later date, according to our analysis, is 2.75 to 1. This ratio was computed using present value analysis and assuming a 7-percent discount rate and a 5-percent inflation rate.

States have not had protective systems installed on existing bridge decks, primarily, because of the lack of Federal and State funds. State officials we contacted indicated that funds available for bridge repair are generally budgeted for bridges so deteriorated that replacement of the deck is the only option. As a result, those existing bridges with little or no deterioration will continue to deteriorate, and eventually require repairs that are much more costly than the cost of the protective systems.

LIMITED APPLICATION OF PROTECTIVE SYSTEMS ON BRIDGES IN GOOD CONDITION

Replies to our questionnaire indicate that lack of Federal and State funds is a major reason why bridge decks still in good condition are not being protected by a majority of the 32 States with a serious bridge deterioration problem. Generally, the States we contacted said that they have a group of bridges so deteriorated that complete replacement of the bridge deck is the only option. Because these bridges have priority for repairs, and all or most of the currently available limited funds are needed to repair them, funds are not generally available for protecting bridges still in good condition.

Maryland's problem illustrates the predicament facing many States. Premature bridge deck deterioration, according to Maryland Department of Transportation officials, is a major problem in the State. It has 2,057 bridges on the Federal-aid system. As of September 1977, only 70 of these decks had protective systems applied or contracts awarded

to protect them. Moreover, even by 1980, the State estimates that less than 10 percent of its bridge decks will be protected against salt applications. State officials cite insufficient Federal and State funds and a shortage of qualified personnel as the primary reasons limiting application of the protective systems to its existing bridge decks.

Maryland's bridge deck problem will continue to grow because it has more bridge decks needing total replacement than funds available. For example, current inspections have identified 80 bridge decks requiring major repair and a protective system that will cost an estimated $20 million. Of these, 60 decks need complete replacement. When the current inspection program is completed, State officials estimate that the total backlog will be between 200 and 300 bridge decks. If the reconstruction work proceeds at the current rate, it could take 20 years just to complete this work. Meanwhile, other bridge decks will deteriorate, adding to the overall problem.

The Federal Highway Administration has recognized the States' funding problems. In its congressionally mandated report which summarized the overall problem, the Federal Highway Administration noted that, unless States' highway revenues are increased either through increased gas taxes or Federal assistance, the magnitude of the Interstate needs will be beyond the States' highway revenue capabilities.

CONCLUSION

The replies to our questionnaire indicate that the lack of Federal and State funds is hampering the placement of protective systems on bridge decks with little or no deterioration. The potential benefit/cost ratio of repairing and protecting existing bridge decks needing only minor repair versus replacing a completely deteriorated deck at a later date is 2.75 to 1. Without such a protection program, the bridges will begin to deteriorate, and will probably need complete replacement long before originally anticipated and at significantly greater cost.

RECOMMENDATIONS TO THE SECRETARY OF TRANSPORTATION

We recommend that the Secretary

--identify those bridge decks on the Federal-aid highway system which can be economically restored at the present time,

--estimate the cost of protecting these bridges, and

--develop a plan for repairing these bridge decks as soon as possible.

AGENCY COMMENTS

In a letter dated November 14, 1978 (see app. II), the Assistant Secretary for Administration, Department of Transportation, stated that the Federal Highway Administration will modify its data retrieval program to better identify bridge decks and their condition on all Federal-aid routes, and thus provide more realistic estimates of the costs of bridge deck restoration to the Congress. This modified data retrieval program should be in operation by 1980. He also said that the funding problem faced by the States should be substantially alleviated by passage of the Surface Transportation Assistance Act of 1978 (P.L. 95-599) which authorizes $4.2 billion of Federal funds for fiscal years 1979 thru 1982 on an 80-20 Federal/State ratio for bridge repairs.

CHAPTER 4

COST-EFFECTIVE METHOD NEEDED FOR STOPPING DETERIORATION OF HEAVILY CONTAMINATED BRIDGES

Many of the existing unprotected bridge decks in 32 States are heavily contaminated. They contain chloride levels above the "corrosion threshold" which will cause the bridge deck to deteriorate and require premature replacement, unless a means is found to halt the deterioration. The Federal Highway Administration has not developed a cost-effective solution for stopping the deterioration of chloride-contaminated bridges decks. An effective solution is needed quickly so that currently repairable, chloride-contaminated bridge decks can be protected and their useful life extended, thereby saving billions of dollars.

NEED FOR COST-EFFECTIVE METHOD OF STOPPING DETERIORATION

The question of whether these physically sound, but chloride-contaminated bridge decks can be protected to achieve their 40-year expected life, has not been resolved by the Federal Highway Administration. In the meantime, the bridge decks continue to deteriorate. A permanent repair procedure of replacing the contaminated portions of the deck is expensive and, as a result, is not being implemented by the States. Numerous techniques have been suggested as possibilities for protecting existing bridge decks from further deterioration. These techniques (which are in various stages of development) include asphalt membranes, concrete overlays, internally sealed concrete, deep polymer impregnation, cathodic protection, and electrochemical removal of chlorides.

However, very limited performance data is available on the effectiveness of these potential protective systems. The problem now is to develop methods to evaluate these systems that have already been identified. Without performance data, the Federal Highway Administration does not know if any of the alternatives will effectively solve the deterioration problem. Before these potential protective systems can be evaluated, additional laboratory research must be completed to

--quantify the oxygen level necessary to support corrosion, and

--develop a method to determine the rate of corrosion of reinforcing steel in existing decks.

It is the opinion of various Federal Highway Administration officials, and the consensus of a 1976 project review conference, that this research would provide the capability to more accurately evaluate protective systems for new deck construction, as well as to evaluate rehabilitation methods. Without this research information, there is no sound method of determining which repair technique should be used for a given set of conditions.

Need to quantify other variables supporting corrosion

The objectives of the research program for bridge deck deterioration have been to investigate methods for controlling or eliminating the corrosion of reinforcing steel in the concrete. The approach has been to explore methods to control or eliminate the effect of chloride--one of the elements, along with oxygen and moisture, required for corrosion to occur.

Some evidence now indicates that controlling oxygen or moisture is also successful. Field evidence is available which shows that membranes/overlays placed over heavily contaminated concrete have reduced the rate of deterioration. Since the chloride level is above that necessary to support corrosion, it is hypothesized that these installations work by limiting the availability of oxygen and moisture. Federal Highway Administration officials told us that there has been no research to quantify the amount of oxygen or moisture necessary to cause corrosion of the reinforcing steel.

Development of evaluation tools being delayed

Existing evaluation methods cannot measure the rate of deterioration of an existing bridge deck. Therefore, it is extremely difficult to determine if, or to what extent, presently installed protective systems are effective. To provide this capability, the Federal Highway Administration plans to develop a "rate of corrosion" tool. This tool will determine the rate of reinforcing bar corrosion and the amount of stress it induces. A companion tool will measure the permeability of field concrete to chloride.

The importance of these tools--particularly the rate of corrosion tool--was highlighted by one Federal Highway official who stated that the evaluation of membrane/overlay systems is awaiting development of this tool.

The development of these tools is not progressing as rapidly as possible due to the lack of funds, even though they are essential for gathering performance data on the potential methods of controlling bridge deck deterioration. During the period beginning in fiscal year 1974 and continuing until fiscal year 1977, very little research was undertaken to develop these tools. As a result, program officials stated that the development of the rate of corrosion and permeability tools have been delayed by about 3 years. Federal Highway Administration officials are hopeful of fielding these tools within 3 to 5 years.

CONCLUSION

Many decks currently contain chloride beyond the "corrosion threshold." The question of how these chloride-contaminated decks can be salvaged has not been answered by the Federal Highway Administration. Several potential protective systems have been identified for extending the service life of bridge decks. However, very limited performance data on the effectiveness of these protective systems is available. Without this type of performance data, the effectiveness of the various protective systems is unknown.

We believe that it is time for the Federal Highway Administration to emphasize the development of evaluative techniques that will rapidly and accurately determine the effectiveness of the various protective systems for chloride-contaminated decks. Time is important. The sooner these issues can be resolved and applied to existing bridge decks, the fewer the decks that will require complete replacement.

A program to protect existing contaminated bridge decks instead of completely replacing them may save billions of dollars. Expanded and accelerated research is the first step. The second step would be to provide funds for installation of the protective system. Based on the experience in placing protective systems on noncontaminated bridges, the lack of funds could also be a major problem which would prevent installation of effective protective systems on contaminated bridges.

RECOMMENDATION TO THE SECRETARY OF TRANSPORTATION

We recommend that the Secretary reassess the progress being made in finding proven, cost-effective methods for protecting existing chloride-contaminated bridge decks, and take appropriate action to resolve any problems that are delaying progress.

AGENCY COMMENTS

In a letter dated November 14, 1978 (see app. II), the Assistant Secretary for Administration, Department of Transportation, said that it plans to continue the search for less expensive, more easily applied, permanent rehabilitation procedures which do not involve removal of large quantities of sound concrete. A new federally coordinated research and development project has been formulated and submitted for funding in fiscal year 1980 for this purpose.

With regard to the development of evaluation tools, the Assistant Secretary said that contracts have recently begun, or are about to begin, on the development of what are believed to be the final tools necessary. These are devices to quickly measure the oxygen content at the level of the reinforcing steel, to measure the moisture content at the level of the reinforcing steel, and to determine the rate of corrosion of the reinforcing steel in existing bridge decks. Further, a device for nondestructive measurement of a bridge deck concrete's chloride content at the level of the reinforcing steel is now in the final stages of prototype testing.

CHAPTER 5

LONG-TERM EVALUATION PROCEDURES NEEDED

States are currently installing various types of protective systems on bridge decks. To validate the effectiveness of these protective systems, it will be necessary to collect and analyze performance data over their expected useful life. This will take between 10 and 35 years, depending on the protective system. Presently, the Federal Highway Administration does not have such a long-term data collection and evaluation program. It needs one.

FORMAL LONG-TERM DATA COLLECTION AND EVALUATION SYSTEM IS NEEDED

One of the Federal Highway Administration's methods of translating research findings into standard use is through its experimental highway construction program. When an experimental item has widespread potential application, the Federal Highway Administration may formally establish a national program which assigns management responsibility for the program to its headquarters staff. Referred to as its "National Experimental and Evaluation Program," the objectives are to encourage States to construct experimental items on Federal-aid projects, and to evaluate their short-term field performance. The Federal Highway Administration established national evaluation programs for the construction of experimental bridge deck protective systems.

We were told that, in general, these National Experimental and Evaluation Program studies are designed to produce quick answers on short-term trends and normally do not extend for more than 3 to 5 years.

Our questionnaire confirmed the short-term nature of most of the current State studies. For example, all 28 respondents that had a moderate to very major bridge deck problem and that had ongoing studies stated that their studies would enable them to evaluate the construction feasibility and/or short-term performance of the systems. However, only three respondents said that their studies would provide a basis for evaluating the long-term effectiveness of the protective systems in achieving the design life of the bridge decks.

Further, analysis of the questionnaire results showed that the evaluation timeframes for the great majority of ongoing studies is 10 years or less, with about 71 percent

having a duration of 5 years or less. A total of 13 studies in five States had no specified evaluation period. Accordingly, we made followup inquiries to officials at four of the five States to determine their estimated evaluation timeframes.

One State official replied that their study of one test deck would be continued until the long-term effectiveness of the system was established. Two State officials estimated that their studies could continue for about 10 years. The other State official replied that the study duration would depend upon the availability of funds and personnel.

Federal Highway Administration officials stated that they have no other program for gathering any meaningful quantity of statistical data other than the National Experimental and Evaluation Program.

We believe, and several Federal Highway Administration officials agreed, that a need exists for the gathering of long-term performance data to validate the engineering decisions which placed several protective systems in the experimental and standard construction categories. Both Federal and State Highway officials stated that, to validate these engineering decisions, it will be necessary to check the bridge decks having protective systems during the expected design life of the protective systems. Since the Federal Highway Administration expects the protective systems to last anywhere from 10 to 15 years for membranes, and up to 35 years for epoxy-coated reinforcing bars, a rather lengthy evaluation is needed to fully assess the effectiveness of the protective systems.

The Federal Highway Administration recognizes that long-term evaluations of protective systems are needed to determine their effectiveness, but have not instituted a formal program to develop this type of data. They plan instead to rely on the States' prompt voluntary reporting of deck failures when they occur to keep abreast of this situation.

CONCLUSION

Weaknesses exist in the Federal Highway Administration's data collection and evaluation system which limit its capability to validate the agency's earlier engineering decisions. No long-term data collection or evaluation process currently exists, although the Federal Highway Administration

recognizes the need for such a process throughout the expected useful life of the various protective systems (15-35 years). If these long- and short-term processes are not improved, efforts to develop usable performance data to resolve the deterioration problem may not be possible.

RECOMMENDATION TO THE SECRETARY OF TRANSPORTATION

To improve its technology evaluation process, we recommend that the Secretary establish a formal long-term data collection and evaluation system for bridge deck protective systems.

AGENCY COMMENTS

In a letter dated November 14, 1978 (see app. II), the Assistant Secretary for Administration, Department of Transportation, acknowledged that a formal long-term system of evaluating those bridge deck protective systems provided by research has not been initiated by the Federal Highway Administration. A program to produce a long-term data collection system for protective systems is scheduled to begin in fiscal year 1979.

CHAPTER 6

SCOPE OF REVIEW

We interviewed officials at Federal Highway Administration headquarters and field offices and reviewed records pertinent to the premature bridge roadway deterioration problem. We also conducted interviews and reviewed records related to bridge protective systems at the Transportation and Highway Departments in seven States.

The review was made at these locations.

--Department of Transportation:

  --Federal Highway Administration headquarters in Washington, D.C.

  --Federal Highway Administration regional offices in Homewood, Illinois; Baltimore, Maryland; Kansas City, Missouri; and Albany, New York.

  --Federal Highway Administration division offices in Maryland, Michigan, Missouri, Nebraska, New Jersey, New York, and Pennsylvania.

--State Transportation and Highway Departments in the same seven States where we visited Federal Highway Administration division offices.

In addition, we sent a questionnaire to the 50 States and the District of Columbia to obtain nationwide information on (1) the magnitude of the problem and (2) the current studies and future plans to evaluate the proposed solutions. We did not verify the information provided to us by the States, although followup inquiries were made to clarify and amplify some of the information.

APPENDIX I

STATES WITH MODERATE TO VERY MAJOR BRIDGE DETERIORATION PROBLEMS (note a)

California
Colorado
Connecticut
District of Columbia
Idaho
Illinois
Indiana
Iowa
Kansas
Kentucky
Maine
Maryland
Massachusetts
Michigan
Minnesota
Missouri
Nebraska
Nevada
New Jersey
New York
North Dakota
Ohio
Oklahoma
Oregon
Pennsylvania
South Dakota
Tennessee
Utah
Vermont
Virginia
West Virginia
Wisconsin

a/New Hampshire and Washington were not considered for inclusion in the above list because they did not provide usable responses.

OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

ASSISTANT SECRETARY
FOR ADMINISTRATION

November 14, 1978

Mr. Henry Eschwege
Director
Community and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

We have enclosed two copies of the Department of Transportation reply to the General Accounting Office (GAO) draft report "Solving Bridge Corrosion Problems Quickly Could Save Billions."

In general, GAO has accurately assessed the bridge deck problem.

[See GAO note 1, p. 21.]

The lack of Federal funding, also, will no longer be a factor in furnishing remedial treatment. The Surface Transportation Assistance Act of 1978 passed by the Congress and which the President has signed now provides adequate Federal dollars for bridge replacement and rehabilitation on an 80-20 ratio. States, however, remain faced with the problem of providing the 20 percent matching funds.

With regard to GAO's recommendations, the Federal Highway Administration (FHWA) has modified its data retrieval program to better identify bridge decks and their condition on all Federal-aid routes and thus provide more realistic estimates of the costs of interstate bridge deck restoration to the Congress. The FHWA research program, since the late 1960's, has been outstanding in this effort to

APPENDIX II

identify the causes of bridge deck deterioration and to provide solutions toward both the repair of old bridge decks and protection of new bridge decks. Some additional research deemed necessary has been programmed for funding in FY 1979. The FHWA agrees with the GAO report findings regarding the present technology evaluation process and actions are underway to improve the program.

If we can further assist you, please let us know.

Sincerely,

for Edward W. Scott, Jr.

Enclosure

[See GAO note 2.]

GAO notes:

1. Deleted material relates to data in our draft report that has been deleted from the final report.

2. The enclosure is not included here. Where appropriate, the report has either been changed or annotated to reflect comments in the enclosure.

(952173)

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