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Problems In Constructing
Segments Of Interstate
Route 71 In Ohio B-118653

Federal Highway Administration
Department of Transportation

*BY THE COMPTROLLER GENERAL
OF THE UNITED STATES*

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096636

MARCH 16, 1972



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

B-118653

C1 Dear Mr. Harsha:

This is our report entitled "Problems in Constructing Segments of Interstate Route 71 in Ohio." The activities discussed in the report are administered by the Federal Highway Administration, Department of Transportation. The report contains additional information concerning a part of Interstate Route 71 discussed in our previous report to you, dated May 21, 1970 (B-118653), and information on the manner in which another part of this highway was constructed. 63 -79

Certain matters discussed in our previous report, principally relating to damage during construction to the property of a city school and hospital and relating to contractor claims for extra costs due to delays, have not been repeated in this report because the status of the matters has not changed.

This report shows that the Federal Highway Administration did not exercise effective control over the construction of sections of Interstate Route 71 in Ohio.

We are also reporting this matter to Congressman Charles A. Vanik at his request. We plan to make no further distribution of the report unless copies are specifically requested, and then we shall make distribution only after your agreement has been obtained or public announcement has been made by you concerning the contents of the report.

Sincerely yours,

Comptroller General
of the United States

The Honorable William H. Harsha
House of Representatives

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ABBREVIATIONS

DOT Department of Transportation
FHWA Federal Highway Administration
GAO General Accounting Office

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D I G E S T

WHY THE REVIEW WAS MADE

The General Accounting Office (GAO) reviewed the construction of two parts of Interstate Route 71 (I-71) in Cleveland, Ohio, to determine why construction problems had been encountered. This report is a follow-up to an earlier report to Congressman William H. Harsha.

FINDINGS AND CONCLUSIONS

Construction problems resulted because the State of Ohio and the Federal Highway Administration were trying to meet the contract date for opening the highway to traffic. The State and the Highway Administration did not

- thoroughly review construction plans,
- require compliance with plans, and
- change the specified opening date when difficulties which obviously would delay completing the highway were encountered.

In an effort to expedite construction, the State and the Highway Administration authorized or permitted the use of other-than-normal construction methods and procedures. Construction problems increased contract costs by \$6.4 million, bringing the cost of the two segments, totaling 2.8 miles, to \$29.3 million. (See p. 10.)

Maintenance problems will require constant surveillance and repairs for several years.

Establishment of highway opening date

Normally the State Department of Highways sets a completion date for a highway only after its specific location has been selected. In April 1963, however, a group of State officials, which was formed to expedite completion of I-71 in Ohio, set a highway opening date of October 1966 before the specific location of the highway had been selected.

To step up the schedule, consulting engineering services were accelerated and reports on solutions to major design problems were not required. Some later construction problems may have resulted from inadequate planning.

To meet a highway opening date, it would have been necessary to complete design and construction plans, acquire rights-of-way, relocate utilities, award contracts, and begin construction in the spring of 1965. Construction contracts were awarded by that time. Some rights-of-way, however, had not been acquired, and utilities had not been relocated. Relocation of utilities was part of the construction contract. (See p. 11.)

Construction problems

Several significant construction problems requiring costly, time-consuming corrective measures were encountered. In an effort to meet the specified opening date, the contractor, with State approval, did not follow normal construction practices.

Damage to bridge piers--Several piers supporting a bridge adjacent to two large embankments cracked and/or moved during construction. The embankments had not been built according to normal procedures. The Highway Administration shared in the \$1.4 million repair costs. (See p. 14.)

Construction of roadway on landfill--The State instructed the contractor to build an embankment and part of the roadway over landfill. After the highway was completed, the embankment began to sink, damaging the roadway and causing it to separate from the surface of a bridge.

A Highway Administration official stated that the State's corrective measure--placing additional layers of pavement on the roadway--was not a permanent solution and that similar corrective measures would have to be continued for several years before the embankment stabilized, assuming that it did not fail completely. (See p. 21.)

The Highway Administration did not participate in the maintenance costs for this section of the highway. It did participate in the construction costs. (See p. 21.)

Purchase of embankment material--To speed up construction by working through the winter, the State, with the approval of the Highway Administration, authorized the contractor to buy special material to use in building embankments.

The special material costing \$786,000 would not have been needed if the State had not decided to expedite construction and if it had used available embankment material.

The Highway Administration agreed to share in the cost of the material. The extent of Federal participation, however, had not been agreed upon. The Highway Administration's decision was inconsistent with its general policy that the Government should not participate in additional costs associated with expediting construction. (See p. 27.)

Inadequate reviews by the Highway Administration

The Highway Administration did not adequately assure itself that the State was building sound, durable, and adequate highways.

Although the Highway Administration's inspectors often had visited and inspected the projects, GAO found no evidence that they had questioned the State's actions or that they had objected to the construction methods used.

GAO believes that, had the Highway Administration carried out its reviews more effectively, many of the construction problems and additional costs associated with the sections of highway discussed in this report might have been avoided or minimized. (See p. 34.)

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Department of Transportation (DOT) stated that:

"In summary, there were extremely adverse field conditions encountered in construction of the projects selected by the GAO for review. These conditions caused some expensive overruns in cost, required much readjustment of contractor's operations, required redesign in some areas, required acquisition of additional right-of-way, and called for a high degree of professional expertise in the field to make engineering decisions on a day-to-day basis. We do not agree that the adverse field conditions can be attributed to inadequate plan review or lack of FHWA field review. There is no real reason to believe that not adjusting time immediately was a factor in increasing the cost of these projects. The extra maintenance now required on the projects is not excessive; it is the least expensive choice to the public considering other possible alternatives."

GAO did not intend to imply that all the adverse field conditions were attributed to an inadequate plan review and a lack of field review by the Highway Administration. GAO believes, however, that many of the problems encountered might have been avoided or minimized if the Highway Administration had made a more thorough review of the project plans and more thorough and timely field reviews.

By not adjusting the highway opening date as construction problems were encountered, the contractors were required to make up lost time caused by the adverse field conditions. Many of the problems encountered were caused by the construction methods followed by the contractors in an effort to expedite the work.

Significant maintenance is required on the sections of highway reviewed by GAO. GAO believes that there is no basis for determining whether the procedures followed were the most economical because sections of the roadway had not stabilized.

DOT's comments and GAO's evaluation are discussed in greater detail on pages 36 through 48.)

CHAPTER 1

INTRODUCTION

The Federal Highway Administration (FHWA), Department of Transportation, is the principal agency of the Federal Government in matters relating to highways. One of its most important functions is the administration of the Federal-aid highway program. Under this program Federal funds to finance the construction of the interstate, primary, secondary, and urban Federal-aid highway systems are made available to all the States, the District of Columbia, and certain territories.

The Federal-aid highway program is a cooperative effort between FHWA and the States. Federal funds generally are provided to a State to cover 90 percent of the cost of constructing interstate highways and 50 percent of the cost of constructing primary, secondary, and urban highways.

Under the program the State is responsible for (1) providing its share of the costs, (2) preparing detailed plans, specifications, and cost estimates for each highway construction project, (3) requesting bids and awarding contracts, (4) administering the contracts awarded, and (5) continually inspecting the work of contractors during construction.

In addition to having responsibility for providing the Federal share of costs, FHWA has primary responsibility for reviewing the manner in which the States carry out their responsibilities and to assure itself that the highways are being constructed in accordance with the plans and specifications. FHWA's functions include (1) reviewing and approving the construction plans, specifications, and cost estimates for each project, (2) concurring in contract awards, (3) monitoring the State's administration of the contracts, and (4) making periodic inspections of the projects during construction. These activities are carried out primarily through a FHWA division office located in each State. The division offices receive advice and assistance from FHWA's regional and headquarters offices.

With regard to its inspection of a project during construction, FHWA's Policy and Procedures Memorandum states, in part, that:

"The principal objective of construction inspection by *** [FHWA] engineers is to ascertain whether or not the State's control procedures are effective in assuring that the construction is being performed in reasonably close conformity with the approved plans, specifications and contract provisions and if not to arrange for the necessary remedial action to be taken. The overall inspection program should cover the quality of materials and workmanship, conformity with dimensional requirements, need for changes or extra work not included in the original contract, adequacy of supervision, inspection and other controls, progress of the work, conditions justifying time extensions *** and other features of importance or interest."

From July 1, 1956--the date which marked the beginning of the interstate highway program--to September 30, 1971, the cost of interstate highway construction projects completed in Ohio amounted to about \$2.1 billion, of which \$1.9 billion represented the Federal share. As of June 30, 1970, the estimated cost of interstate highway projects under construction or authorized in Ohio amounted to about \$415 million, of which about \$362 million represented the Federal share.

In May 1970 we provided Congressman Harsha with a report containing information on certain aspects of the construction of a part of I-71 in Cleveland (B-118653). We later expanded our review to determine the causes of problems encountered in the construction of another part of this highway. Our review included two parts of I-71 located in highly industrialized and densely populated areas within the city limits of Cleveland. The State divided the work necessary to complete the two parts into three projects--projects 79, 27, and 222--which, in total, involved the construction of about 2.8 miles of interstate highway.

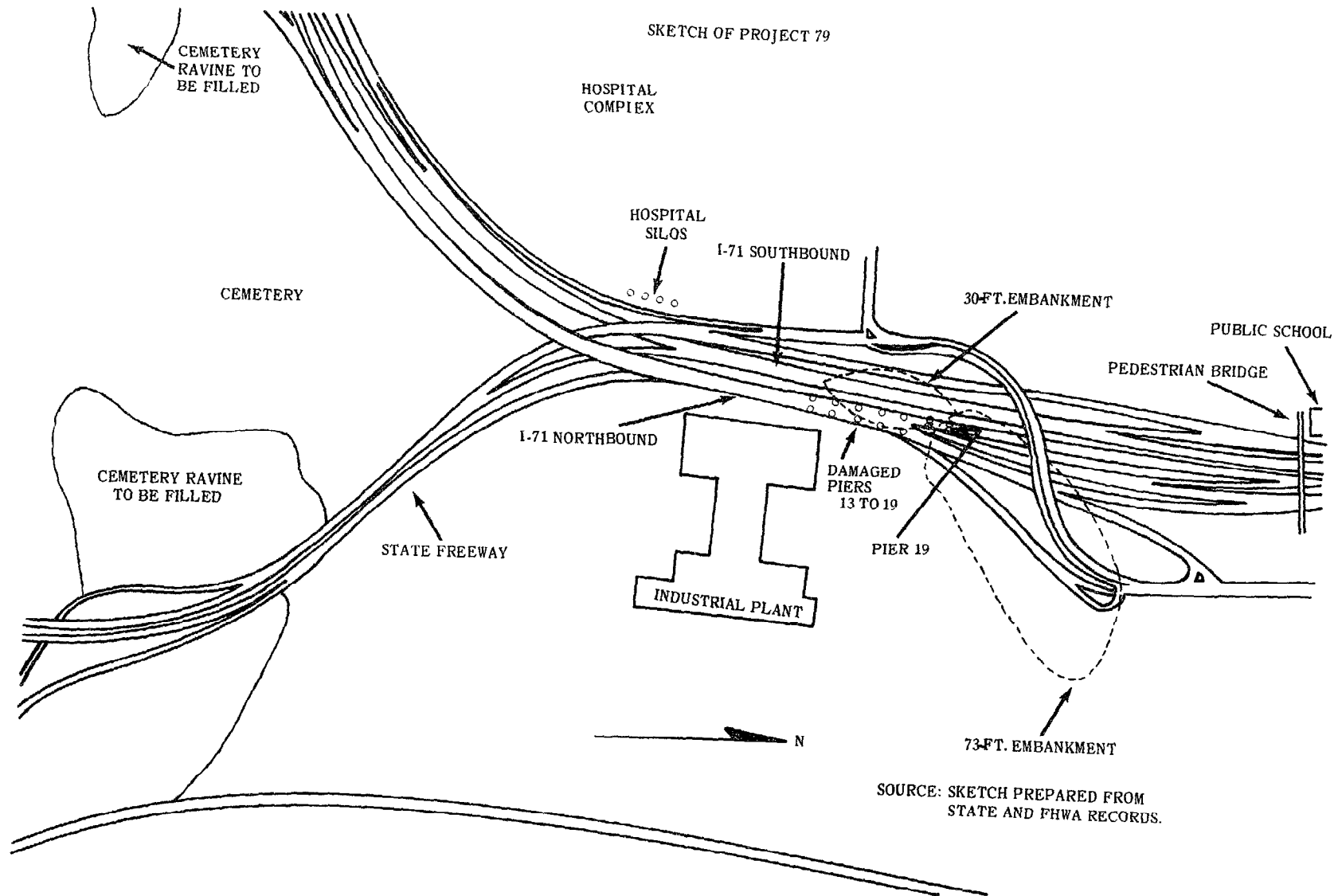
Project 79 is about 0.7 mile long and includes the construction of 20 lanes, five bridges, a detour road through a steel plant's property, and two large embankments. It is located in a relatively narrow 400-foot-wide right-of-way, necessitating the construction of several roadways crossing over one another at different levels and of several complex interchanges. A sketch of the project is shown on page 8.

A unit-price contract in the amount of about \$14.5 million was awarded by the State of Ohio in April 1965 for the construction of the project. It represented the largest single contract for highway construction in Ohio up to that time and specified a date of October 31, 1966, for the opening of the highway to traffic and a completion date of November 30, 1967, for all work under the contract.

Through the use of crossovers--temporary roads connecting finished sections of the highway--two lanes of traffic in each direction were provided in February 1968, about 16 months after the date specified in the contract for such two lanes. Full use of these sections of I-71 was provided on August 30, 1968, and the project finally was completed in December 1968. The State granted, and FHWA approved, all time extensions.

As of May 1971, the contract had not been closed out and the final cost of the project was still being determined. At that time the total estimated cost under the contract was \$19.9 million, an increase of about \$5.4 million over the initial contract amount.

Projects 27 and 222 are located about one-half mile southwest of project 79. Initially these two projects were considered as one project primarily consisting of the construction of a 2.1-mile section of I-71 and the relocation of a creek. In 1963, however, a railroad company suggested that its tracks be relocated to eliminate the necessity to construct three of the bridges planned to carry the highway over the tracks. A consultant's report indicated that about \$886,000 could be saved by following the railroad company's suggestion. As a result, the relocation of both the creek and the railroad tracks was made a separate project (project 27) and a contract in the amount of about \$2.2 million



was awarded for this purpose in March 1965. The contract specified a completion date of April 15, 1966. The new tracks became operable in December 1965; the remainder of the contract work was completed by September 1967. Time extensions were granted by the State and approved by FHWA.

Project 222 consisted of the construction of the 2.1 miles of highway, including several bridges, an interchange with a freeway, and a restricted extension of one of the city's streets. A unit-price contract in the amount of about \$6.2 million was awarded by the State in June 1965 for this work. The contract specified October 31, 1966, as the date for opening the highway to traffic and October 1967 as the date for completion of the entire project. This section of highway was opened to traffic in October 1967, about 1 year later than specified in the contract. The entire work under the contract was completed in May 1969. Extensions for nearly all the additional time were granted by the State and approved by FHWA. The cost under the contract exceeded the initial contract amount by about \$1 million.

CHAPTER 2

ADMINISTRATION AND CONTROL OF

HIGHWAY CONSTRUCTION PROJECTS NOT EFFECTIVE

In an attempt to adhere to the contract date for opening I-71 to traffic, the State of Ohio and FHWA (1) did not adequately review construction plans, (2) did not require compliance with the construction plans, or (3) authorized or permitted the use of other than normal construction methods and procedures in an attempt to expedite the construction of the highway.

Significant construction problems were encountered, and contract costs for the three projects increased from about \$22.9 million to \$29.3 million, an increase of about \$6.4 million. Of this \$6.4 million, about \$2.2 million represented costs to repair or rebuild sections of the projects, about \$3.3 million represented contractors' claims related to delays, and about \$800,000 represented costs to expedite the construction of the projects. In addition, there was about \$1 million in costs on these projects that were not associated with the construction contracts.

A significant maintenance problem has been encountered since the highway was opened to traffic. According to FHWA certain segments of the highway will require constant surveillance and maintenance for several years.

FHWA agreed to allow Federal participation in most of the increased cost of \$7.4 million. We believe that, had FHWA carried out its review responsibilities more effectively, many of the construction problems and additional costs associated with the projects might have been avoided or minimized. FHWA's lack of effectiveness in carrying out its overview responsibilities on these projects is demonstrated by (1) its concurrence in the highway opening date specified in the contracts even though that date was set before sufficient information was available to ensure that it was reasonable, (2) its inadequate review of construction plans, (3) its failure to require the State to adjust the opening date specified in the contract when difficulties which obviously would delay opening the highway were

encountered, and (4) its tacit approval, or lack of knowledge, of construction practices involving higher-than-normal risk authorized by the State in attempts to meet the opening date of the highway.

ESTABLISHMENT OF HIGHWAY OPENING DATE

In April 1963 State of Ohio officials established a group composed of persons from the Department of Highways, the state attorney general's office, and the Ohio Turnpike Commission. At that time I-71 was complete or under construction from the southern suburbs of Cleveland to the northern suburbs of Cincinnati, Ohio. The objective of the group was to expedite the completion of I-71 and to open it from the suburbs of Cincinnati to downtown Cleveland by October 1966.

Normally construction periods and completion dates for highway projects are established by the State highway departments. For the three I-71 projects we reviewed, however, the completion date was established by the expediting group. According to the expediting group's first annual report, the chairman of the group stated, at the group's initial meeting in April 1963, that the highway was to be opened to traffic by October 1966 and that he hoped that no extensions beyond that date would be granted.

At the time the opening date was established and agreed to, the specific location of the three projects had not been selected. Representatives of FHWA's division, regional, and headquarters offices who were present at the initial meeting apparently did not question whether the October 1966 opening date was attainable, even though the establishment of a highway opening date normally is not made until the specific location of the highway has been selected.

In Ohio two construction seasons are considered a normal period within which to construct a highway project. A construction season generally is from May through October. To meet the October 1966 opening date, under normal construction practices, it would have been necessary to complete design and construction plans, acquire rights-of-way, relocate utilities, solicit bids, award construction contracts, and begin construction by April 1965 on all three highway projects.

We found that, in an effort to expedite the construction of the highway projects, consulting engineering services had been accelerated and requirements for reports on the resolution of all major design questions prior to the preparation of detailed construction plans had been eliminated by the State. The State informed its consulting engineers that it had been unable to review thoroughly the construction plans as they related to the structures to be constructed but that it trusted that the consulting engineers had done an adequate job. FHWA's procedures require that it review these construction plans. FHWA officials advised us, however, that, because of the heavy work load and the efforts to expedite the three projects, sufficient time had not been available to perform an adequate review of the plans for the structures and greater reliance had been placed on the State's review. The adequacy of the plans, especially as they related to the structures, became a central issue in certain of the construction problems later encountered.

The contracts for the three projects were awarded in March, April, and June 1965, respectively. At the time of the contract awards, some rights-of-way had not been acquired and necessary utility relocations had not been completed. The relocation of utilities was part of the construction contracts. In addition, to complete project 79 on time, a detour road to carry existing traffic around the construction site had to be completed by April 1965. The construction of the detour road, however, was not completed until August 1965, about 4 months later than required and about two thirds of the way into the first construction season.

Each of the problems discussed in the following sections of this report resulted, either directly or indirectly, from actions taken by the State in attempting to complete the highway construction so that it could be opened by October 1966. The projects' records show that FHWA was aware, at the time it approved the contracts, that the steps necessary to meet that date had not been completed but that it did not require that the specified opening date included in the contracts be changed nor inquire as to how the State

expected to meet the opening date in view of the delays in preparatory work that had already been experienced.

The problems encountered during construction made the attainment of the specified opening date more unrealistic as construction progressed, but FHWA took no action to require that the date be adjusted. FHWA policies and procedures specifically require that, when situations occur during construction which necessitate adjustments to the specified opening date, prompt agreement be reached with the State on such adjustments.

ACCELERATED CONSTRUCTION TECHNIQUES
AND RELATED CONSTRUCTION PROBLEMS

Shortly after the contractors started working on the three projects, several significant construction problems were encountered that required substantial, costly, and time-consuming corrective measures. These problems were associated with the contractors' use, with State approval, of other-than-normal construction practices in an attempt to meet the specified highway opening date. FHWA's inspectors made numerous visits to and inspections of the project, but the record of such visits and inspections contained no evidence that they had questioned the State's action or that they had objected to what was occurring. On several of these visits, the inspectors were accompanied by FHWA region and headquarters employees.

Damage to bridge piers

The longest and most complex of the five bridges on project 79 has two decks and is supported in the middle by common piers. Plans provided for the construction of two large embankments--30 feet and 73 feet, respectively, at their highest points--adjacent to each other and to the bridge. The 73-foot embankment provides support for the north end of the bridge and certain of its piers. The 30-foot embankment is parallel to the bridge and supports sections of I-71. (See sketch on p. 16.)

Project records showed that piers 10 through 18 supporting the bridge had been constructed prior to the construction of the 30-foot embankment and that pier 19 and the 30-foot embankment had been constructed concurrently. Piers 1 through 9 were not located adjacent to the embankments and were not involved in the pier damage discussed below.

In May and June 1966, cracks and/or movements were detected on piers 13 through 19 which support the bridge. Shortly after the damage was detected, the State requested its consulting engineers for the project to determine the extent of damage and the probable cause and to recommend appropriate corrective measures. The consulting engineers, in a report dated July 1, 1966, stated that the probable

cause of the damage was the consolidation of the underlying subsoils of the 30-foot embankment that produced an underground lateral movement which acted against the piles supporting the piers. (See sketch on p. 16.)

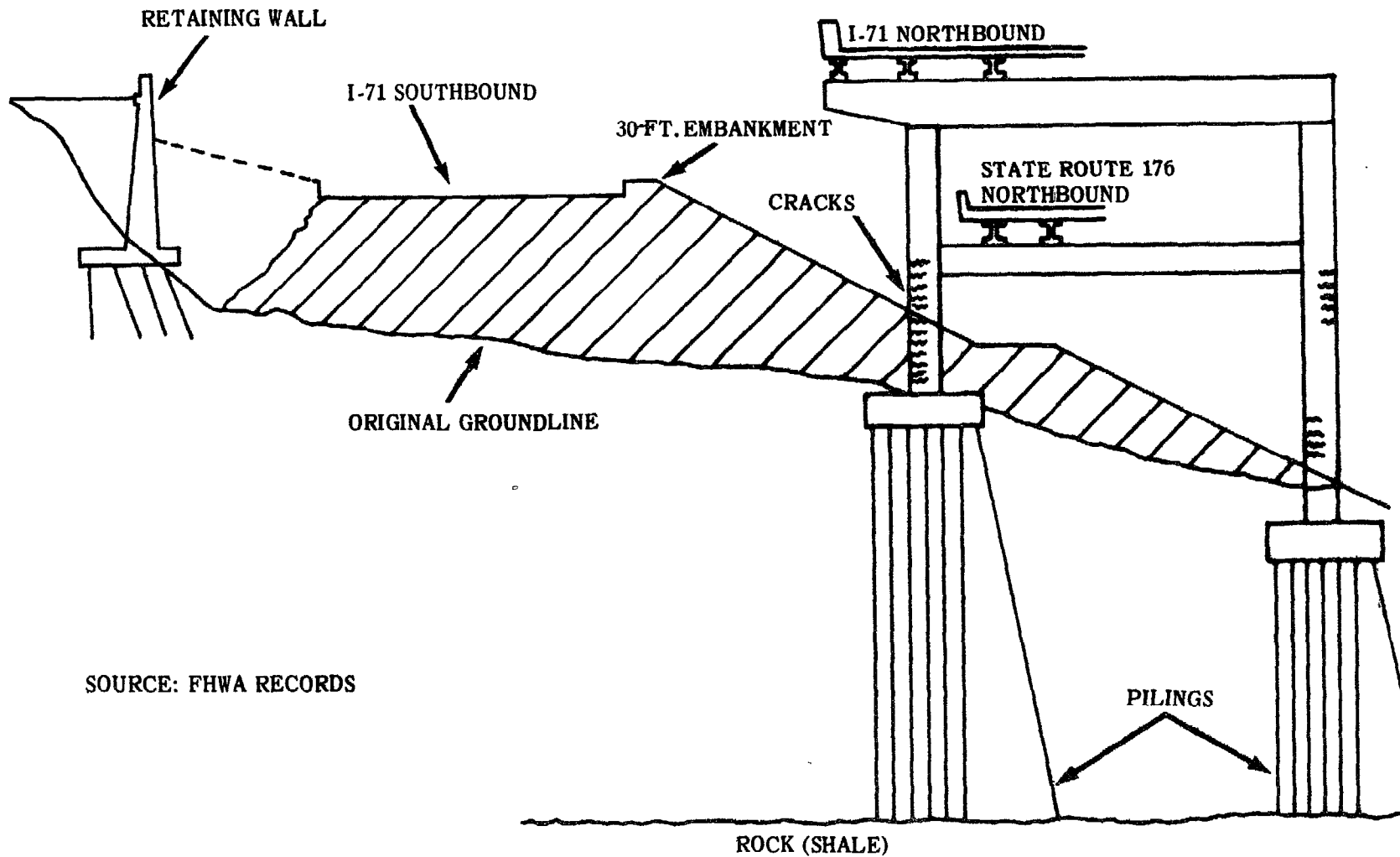
After the piers cracked and/or moved, substantial controversy arose in determining responsibility for the damage and whether the cost of repairing the damage was eligible for Federal financial participation.

According to the consulting engineers' July 1966 report, normal construction practices call for first constructing the embankments and then placing the structures in the embankments. The report stated, however, that this sequence had not been followed in the construction of the 30-foot embankment and that the piers had been built prior to the construction of the embankment. The report stated also that the reasons for the departure from normal construction practices had been related primarily to the problems of location of utilities and the expedited construction schedules.

The State, in a letter dated January 26, 1967, advised FHWA that it did not agree with the consulting engineers that the embankments and piers had been constructed using other-than-normal construction practices. The State also stated that the piers had been constructed in accordance with the plans and specifications prepared by the consulting engineers, that the plans had been approved by FHWA, and that at no time during the inspection of the project from July 1965 to June 1966 had any questions been raised with respect to the sequence of construction by representatives of FHWA or by the consulting engineers. The State concluded, therefore, that the cost of the modified methods required to correct the damage and to complete the facility represented allowable project costs eligible for full Federal participation.

Essentially the dispute between the State and its consulting engineers concerned the clarity of certain cautionary notes contained in the plans. The State's bridge engineer, by letter dated July 9, 1964, had instructed the consulting engineers to include directions in the plans requiring that all embankments be completed prior to the erection of any piers. The notes contained in the plans,

CROSS-SECTIONAL SKETCH
SHOWING PROXIMITY OF PIERS AND EMBANKMENT (AT PIER 16)



SOURCE: FHWA RECORDS

however, were not identical to those called for by the bridge engineer. This difference was not detected during the State's review of the plans.

In a letter dated October 18, 1966, to the Director of the Office of Engineering and Operations in FHWA Headquarters, the FHWA Regional Administrator expressed the belief that the cautionary notes were self-explanatory and that good construction procedure dictated the placement of an embankment prior to the erection of any piers. He pointed out that the piers were not designed to take a horizontal load, such as that caused by the movement of the subsoil beneath the embankment, and that it should have been obvious that the construction procedure followed was not sound and involved some risk.

Moreover the Regional Administrator pointed out that the primary responsibility for, and control of, the project rested with the State Highway Department. In addition, FHWA regional and Washington representatives visited the site in the fall of 1965 and, after observing that complex soil problems existed and that project personnel were not exercising adequate control over the construction of the embankments, recommended that the State employ a soils expert. The State subsequently assigned a geologist in connection with embankment work on the three projects.

As a result of various meetings and correspondence, FHWA later reversed its position and authorized Federal participation in the cost of stabilizing the embankment. The justification for this decision stated, in part, that:

"*** acceptance is given that the construction operations were performed in the manner intended by the State and in substantial conformity with the State's plans for the project, but the higher than normal risk assumed by adopting and then following such construction operations was a judgment decision by the State not objected to by Public Roads and probably not recognized or known by Public Roads engineers."

The Director, Office of Engineering and Operations, in approving Federal participation in the costs, indicated

that very likely there would be other requests for Federal participation in the cost of repairs to the damaged piers and that, having accepted liability in this instance, there would be little or no basis for withholding participation in other such requests.

The damaged piers subsequently were repaired, and the State requested Federal participation in the repair costs. FHWA agreed to participate in these costs, except those associated with pier 19, the cost of which had not been allocated. The total cost to stabilize the embankment and repair the piers amounted to about \$1.4 million.

As early as the fall of 1965, FHWA knew that the State was not exercising proper control over the construction of the project embankments. Even though FHWA had recommended that the State hire a soils expert in connection with the construction of the embankments, the FHWA inspection reports did not question the manner in which the embankments were being constructed.

We believe that FHWA, had it carried out its inspection responsibilities properly, could have advised the State that the construction practices being used involved higher-than-normal risk and that Federal financial participation would not be allowed in any additional costs resulting from the use of such practices.

In any event it is unclear to us how FHWA could have concluded that the construction operations had been performed in the manner intended by the State when the State's bridge engineer had specifically instructed its consulting engineers that the plans showed that embankments were to be completed prior to the erection of piers. Also our review of project records showed that the 30-foot embankment had been constructed in a manner contrary to State requirements. Pertinent State specifications dealing with embankments require, in essence, that, when an embankment is placed on a slope of material other than rock (as was the 30-foot embankment), the slope be placed in layers across the entire area to be embanked. This procedure is designed to provide stability and strength to an embankment.

Notwithstanding these requirements the 30-foot embankment actually was constructed in two distinct parts at two different times. The eastern part nearest the piers was constructed during the period May 3 through June 3, 1966. Because of delays in relocating gaslines and waterlines from the area on which the western part was to be placed, that area was not available for embankment work until the eastern part was substantially completed. At that time, damage to the piers was noted and further work on the 30-foot embankment was suspended until the matter was investigated. The project records contained no evidence that either State or FHWA inspectors had taken any issue with the manner in which the 30-foot embankment had been constructed.

While the piers were being repaired, monitoring equipment was installed to help analyze the pier movement problem. Later the equipment was used to record the water content and movement of the earth in and around the embankment adjacent to the location of the piers. The equipment disclosed an above-average amount of water in the area of the embankment but did not disclose any additional movement of the earth.

The State became concerned, as a result of information included in studies performed by its project consulting engineers, as to what effect excessive water would have on the stability of the embankments and employed another consulting engineer firm to determine the causes of, and solutions to, this condition. In a report dated December 1968, the consulting engineer firm stated that during a normal rainfall about 400,000 gallons of water an hour from the city's sewers seeped through the project area. Although the firm recommended a remedial program to the city, no action had been taken as of May 1971.

Subsequent to December 1968 the State entered into an agreement with its project consulting engineers to determine the effect of seepage of water from the sewer. In September 1969 the project consulting engineers stated that the rate of seepage then being experienced was not considered serious but that a significant increase in seepage could create a critical problem. They recommended that seepage and ground water conditions be observed each rainy season and stated that any significant increase in the water

level would have to be observed carefully. Continuous observations are being made by the State to monitor and evaluate the impact of water seepage and earth movements on the piers. Damage noted during construction that was too slight to require immediate repair also is being observed by the State.

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Construction of roadway on landfill

Construction of the section of the highway in project 222 required building an elevated bridge over relocated railroad tracks and an embankment for a roadway leading up to the bridge from ground level. Soil borings taken before construction began showed that part of the area on which the embankment was to be placed was an old landfill containing trash and garbage. The borings, however, did not show the full depth of the landfill because they did not penetrate through the landfill to the ground below. Construction plans required excavation of the landfill to a depth which approximated the depth of the soil borings.

In October 1965 the contractor informed the State that excavations had been made to the level shown in the plans but that additional landfill remained. At the direction of the State, an additional 3 feet of landfill was removed for a distance of about 200 feet from the bridge abutment. The contractor advised the State that additional landfill with a depth up to 25 feet and extending 100 additional feet remained and that construction of the roadway over the landfill would be at the State's risk. The State, however, instructed the contractor to construct the embankment and roadway over the remaining landfill following the plans provided in the contract for the construction of this part of the roadway.

Shortly after this part of the highway was completed, the embankment was observed to have sunk, causing damage to the roadway leading to the bridge and creating an elevation differential between the surface of the roadway and the surface of the bridge. The elevation differential occurred because the bridge abutment had been built on pilings driven to bedrock and could not sink. The roadway, however, was constructed on the embankment built over the landfill area that was being compacted by the weight of the embankment, which caused the roadway to sink.

In an effort to achieve a rideable roadway surface, the State mud-jacked the highway--drilled holes and forced material under the surface of the roadway--even before it was opened to traffic. Because this failed to keep the roadway level with the bridge, the State began laying additional

layers of asphalt (overlays) on the road. At the time of our review, three overlays had been placed on the roadway. The embankment, however, has continued to sink, causing damage to the roadway leading to the bridge, a retaining wall, guardrails and lighting fixtures of the roadway, and the abutments to the bridge. (See photographs on pp. 24 to 26.)

The State requested Federal participation in the cost of the mud jacking and overlays principally on the basis that the work had been performed according to the plans and that the decision not to remove the additional landfill had been a calculated risk taken in the interest of economy.

The Regional Federal Highway Administrator declined to permit Federal participation on the basis that these efforts were considered to be in the nature of maintenance. In a letter to the State, he pointed out that it was the State's responsibility to initiate the designs for highway projects and to decide on the degree of risk it was willing to assume in constructing the highway. He stated that mud-jacking and overlaying the roadway had provided a temporary expedient for carrying traffic over a basically inadequate foundation without providing any lasting solutions. He stated also that work of this nature might be required for several years before the embankment stabilized, assuming that it did not fail completely.

FHWA should have been aware during construction that the additional landfill was present. There is no record, however, that FHWA objected to the State's decision to construct the highway over the landfill.

Although FHWA did not participate in any of the cost of the remedial work on this section of the highway, we believe that, in a program of this nature in which the Federal Government provides 90 percent of the funding, it is incumbent upon the administering agency to ensure a sound investment of Federal funds. In our opinion, this responsibility requires FHWA to take whatever action is necessary to ensure that the States construct sound, durable, and adequate highways. In view of the remedial work required before the highway could be opened to traffic and in view of the significant continuous maintenance required to keep

the highway open, it does not appear, either in this instance or in the case of the piers that cracked, that FHWA adequately met this responsibility.

Current status

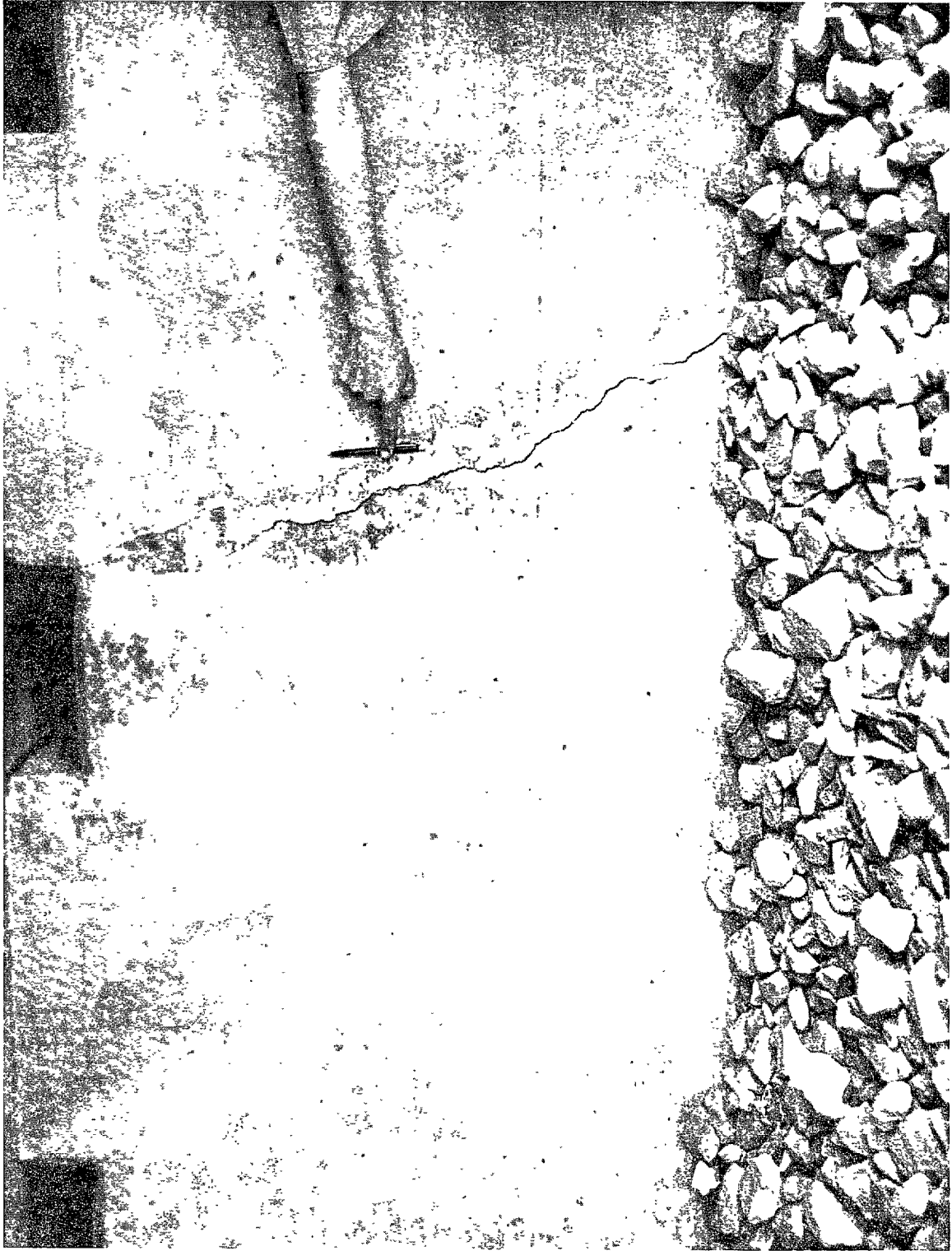
As of July 1971 the roadway had settled about 2 feet and was continuing to settle. State officials informed us, however, that they believed that the roadway was structurally sound. They also said that the State was not monitoring the continuing settlement or its effects on the bridge abutment. Continuing maintenance to achieve an acceptable, rideable surface does not appear to be a satisfactory solution. Also the roadway has at times represented a traffic hazard. We noted that on one occasion the Cleveland Police Department had attributed the cause of an accident to the defective road.



Photograph furnished by
Ohio State Highway Department

Separation of roadway and bridge abutment.

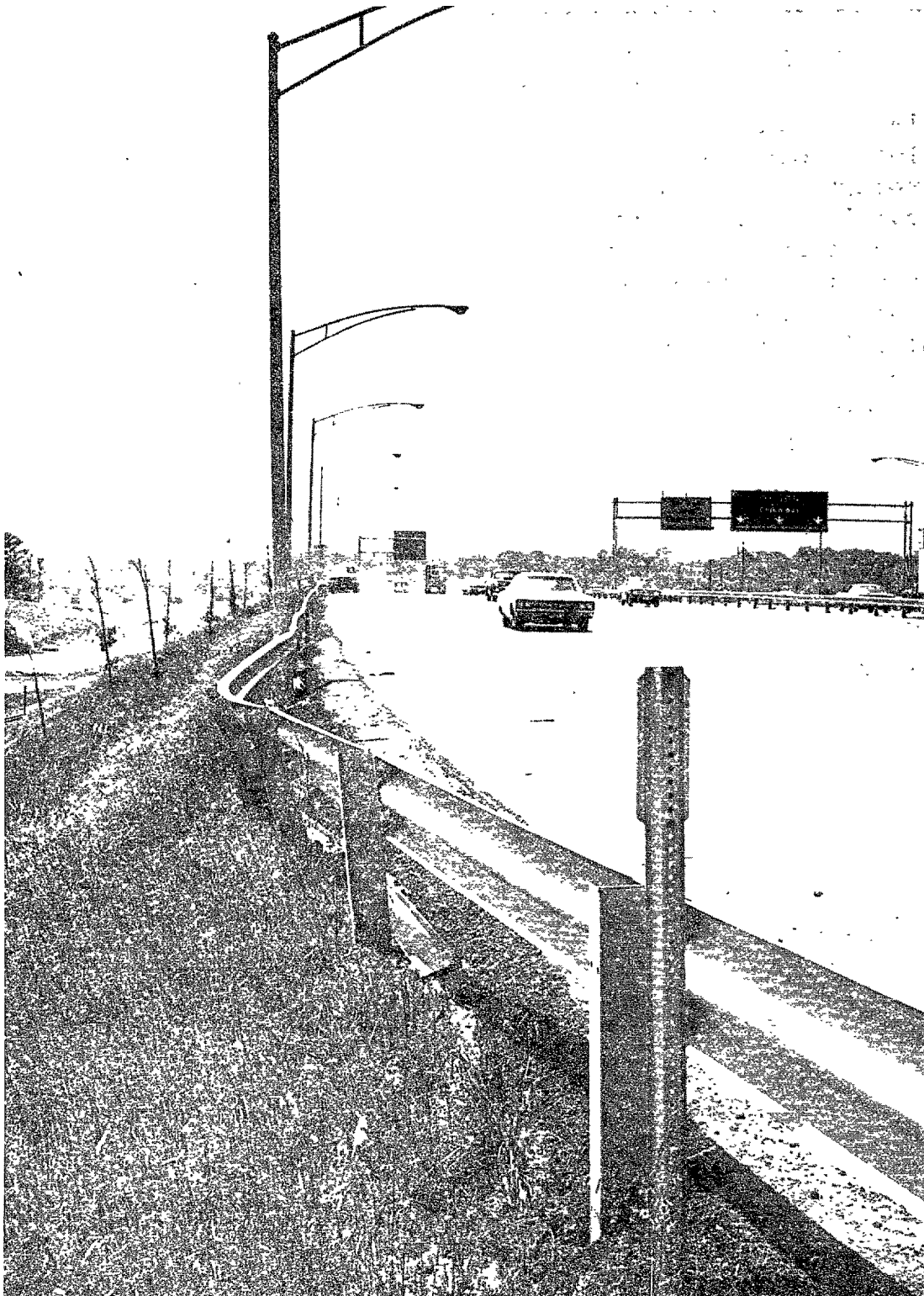
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Photograph furnished by
Ohio State Highway Department

Crack on bridge abutment.

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Photograph furnished by
Ohio State Highway Department

Guardrail and lighting fixtures sliding as a result of compaction of embankment on landfill.

Purchase of embankment material

The State, with FHWA approval, authorized the contractors for projects 79 and 222 to purchase, and to put in place during the winter, special fill material suitable for winter work. The State justified this action partly on the grounds that suitable material did not exist in sufficient quantities in the project areas, as originally anticipated, to complete the embankments. Our review showed, however, that, if the State (1) had not decided to expedite construction by continuing work during the winter and (2) had used materials which were obtained through excavation in the project areas, the purchase of the special material would not have been necessary. The purchase of this material increased the construction costs by about \$786,000.

FHWA has not agreed to the amount of Federal participation that may be allowed in the costs associated with the use of the borrow material (embankment material) pending resolution of certain questions dealing with other earthwork operations (excavations and construction of embankments) on the projects. FHWA's participation in the costs related to the work is inconsistent with its general policy of not sharing in additional costs associated with expediting construction.

Project 79

Construction plans for project 79 showed that substantial earthwork operations were required. The plans showed also that a sufficient quantity of material, if the material was found to be suitable, would be available from excavations in the project area to satisfy the quantity requirements for the embankments. Under the State's normal procedures, all available suitable material on the project should have been used for embankments before any additional material was purchased. About 45,000 cubic yards of slag, however, were purchased at an additional cost of about \$333,000 to complete one embankment, primarily to allow the embankment work to proceed during the winter of 1965-66 in an attempt to meet the opening date of the highway of October 1966. Prior to the purchase of this material, a larger quantity of material suitable for the embankment work had been removed from the project.

State specifications provide generally that embankment work be done in the summer because of problems associated with building embankments in the winter. The completion of the subject embankment by the fall of 1965 was critical to the opening of the highway by October 1966 because the plans provided for allowing the embankment to settle for 10 to 12 months before erecting certain structures in it. The embankment, however, was not completed by the fall of 1965, primarily because (1) embankment work could not be started until unstable material had been excavated from the embankment area and (2) the relocation of utility lines through the embankment had been delayed by a landslide in the project area.

Consequently the State, with FHWA approval, authorized the contractor to purchase material suitable for winter use and to construct the embankment during the winter in an attempt to meet the October 1966 opening date. The embankment, however, was not completed until March 1966, and the State waived the settlement period in a further attempt to meet the specified opening date. FHWA advised the State that it would not allow Federal participation in any additional costs associated with problems that might result as a consequence of the decision to waive the settlement period for the embankment.

FHWA's approval for purchasing special material was given after the contractor had partially completed the embankment with suitable material obtained from excavation in the project area. The approval was predicated, in part, on the State's assertion that the remaining material available for excavation in the project area contained excessive moisture and could not be used. The State and FHWA agreed that, because it would be necessary to purchase material, it was desirable to purchase special material that could be used in winter. The purchase of this material and its placement in the embankment was negotiated by the State on a sole-source, noncompetitive basis at a cost of about \$7.40 a cubic yard compared with one construction contract price of \$0.75 a cubic yard for material obtained in the project area.

Project records showed that, prior to the decision to purchase special material, about 48,000 cubic yards of

material suitable for construction of the embankment had been excavated in the project area and had been placed in ravines in a cemetery. When it was recognized that there might be a shortage of material for construction of the embankments, the State realized that the use of material suitable for that purpose was not necessary for placement in the ravines and modified the contract accordingly. Also, before the special material was purchased for the embankment, about 105,000 cubic yards of material were removed from the project area without first testing whether it was suitable for use in an embankment. Thus it appears that, with proper management, suitable material, in excess of the 45,000 cubic yards of material purchased, should have been available to complete the embankment during the normal construction season which began in May 1966.

A maintenance problem has resulted because two types of material were used to construct the embankment. Granulated slag--the material purchased for the embankment--solidified to a relatively hard consistency. We noted that, because of the differences in the two types of material used for the embankment, the embankment had a hard, stable top with relatively soft dirt on the bottom. The picture on page 30 shows that, as a result of erosion, some of the bottom part of the embankment has washed away but that the top of the embankment has remained relatively stable, which necessitated additional maintenance by the State.

Projects 27 and 222

Construction plans for projects 27 and 222 also showed that substantial earthwork operations were required and that a sufficient quantity of material, if the material was found to be suitable, would be available from excavations in the project areas to satisfy the quantity requirements for constructing the I-71 embankments. The plans showed also that the I-71 embankments were to be built with the excavated material, if it was suitable, and that any excess material could be used to construct embankments for a future expressway and a restricted extension of a city street.

We found that, even though sufficient suitable material was available from excavation in the project areas to construct the I-71 embankments, the State, with FHWA approval,

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Photograph furnished by the
Ohio State Highway Department

had authorized the contractor for project 222 to buy and place about 188,000 cubic yards of special material, referred to as shale, at a cost of about \$453,000, to complete the embankments during the winter months. FHWA's approval was predicated, in part, on advice from the State that (1) there was much less material available in the project 27 area than anticipated because of an error in the plans and (2) material remaining to be excavated in the project area was not suitable for use in embankments because of its high moisture content. FHWA concurred in the State's view that, since it would be necessary to purchase material, it was desirable to purchase the type of material which would permit continuation of construction during the winter months. The purchase of this material and its placement in the embankment was negotiated by the State on a sole-source, noncompetitive basis at an average cost of \$2.42 a cubic yard.

If the State had adhered to the plans for both projects, the purchase of special material would not have been necessary. The plans showed that excess material would result from the excavation required. In expectation of such an excess, the plans provided that excess material could be used by the contractor for project 27 to construct embankments on the future expressway and by the contractor for project 222 to construct an embankment for the extension of a city street. The plans provided also that, should a deficiency in material occur, the embankments for I-71 be given first priority for the use of the material excavated.

The contractor for project 27 began work in March 1965. In May 1965 the State's project engineer noted that the embankment for the future expressway was being constructed concurrently with the embankments for I-71. He advised the contractor that the plans were in error as to the amount of material available for excavation and that there was some concern over the moisture content of the material being excavated. He reminded the contractor that only material excess to the needs for the I-71 embankments could be used for the non-I-71 embankments. The contractor stated that he was stockpiling the material excavated in the project area until it could be used on the I-71 embankments. At that time about 121,000 cubic yards of suitable embankment material had been placed as an embankment for the future

expressway. The records for project 222 also indicated that the contractor had placed about 229,000 cubic yards of suitable excavated material as an embankment for the city street.

In July 1965 the project engineer again expressed his concern to the contractor for project 27 that first priority was not being given to using excavated material to complete the embankments on I-71 and again the contractor stated that he was stockpiling the material and would move it at a later date. Although the excavated material placed at the other locations far exceeded the amount of special material purchased, the project records contained no evidence that the State had adequately considered the possible use of that material for the I-71 embankments, in accordance with project plans, prior to requesting FHWA's approval to purchase the special material.

- - - -

In summary, sufficient suitable material was available from excavations in the two project areas for construction of the I-71 embankments. Thus it appears that the State's purchase of special material to complete the embankments would not have been necessary, except in an attempt to meet the specified opening date of the highway by expediting construction.

FHWA's decision to participate in the costs associated with the purchase of the special material was inconsistent with its general policy that the Government not participate in additional costs associated with expediting construction. The State proposed the use of expediting efforts to help complete the project by the specified opening date. In September 1966 FHWA informed the State that such costs would not be eligible for Federal participation. Again, in December 1967, FHWA, in disallowing Federal participation in certain material-handling costs in connection with pier repairs, advised the State that:

"*** We have informed you in previous correspondence that Federal funds cannot be expended to expedite the opening of a highway. This is an established Bureau of Public Roads' policy supported by our higher authority.***"

The FHWA policy referred to above provides that Federal financial participation in highway construction costs not be allowed, either directly or indirectly, in any effort on the part of a State or a contractor to expedite construction. FHWA recognized that such participation rarely could be justified because it would be susceptible to abuse.

CONCLUSIONS

The construction problems encountered on those parts of I-71 discussed in this report resulted, either directly or indirectly, from attempts by the State to expedite construction. Although the contractors had fallen behind in meeting the opening dates specified in the contracts, FHWA did not attempt to have the State extend the dates. To the contrary we noted that FHWA, in some cases where it knew, or should have known, that the State was following other-than-normal construction methods in an attempt to expedite construction, had approved the use of such methods and had participated in the additional costs involved. In addition, the projects' records do not indicate that FHWA had questioned the sequence of construction or the construction methods being employed, which ultimately led to the difficulties on the projects, until after the problems arose.

FHWA participated in the cost of most of the remedial work required, primarily on the basis that the State's decision to change the sequence of construction and to use other-than-normal construction practices was not objected to by FHWA during construction and probably was not recognized or known by FHWA engineers. In addition, FHWA approved the State's decision to purchase, and to put in place during the winter, special fill material in order to expedite the construction of embankments on two of the projects. FHWA's decision to allow Federal financial participation in the cost of such material was inconsistent with its general policy of not sharing in additional costs associated with actions taken to expedite project completion.

Had FHWA carried out its review responsibilities effectively, many of the construction problems and additional Federal costs associated with the three projects might have been avoided or minimized. FHWA's ineffectiveness in carrying out its responsibilities on these projects is indicated by its (1) inadequate review of construction plans, (2) concurrence in the establishment by the State of an opening date even though that date was set before sufficient information was available to ensure that it was reasonable, (3) tacit approval, or lack of knowledge, of construction practices involving higher-than-normal risk authorized by the State in attempts to meet the opening date, and (4) failure

to require the State to adjust the specified opening date when construction problems were encountered.

Under the Federal-aid highway program, in which the Federal Government provides 90 percent of the funding, it is incumbent upon FHWA to ensure a sound investment of Federal funds. This responsibility requires that FHWA take whatever action is necessary to ensure that the States construct sound, durable, and adequate highways.

The onsite inspection of the construction of a Federal-aid highway is one of the most important tools available to FHWA for carrying out its responsibilities. It is imperative, therefore, that such inspections be thorough and that inspection reports provide sufficient information to inform management of the construction methods and procedures being used and of existing or potential problems which may affect the completion or the quality and soundness of the highway being constructed. Only if such matters are brought to the attention of the State and higher FHWA officials can potential problems be solved or averted before they actually take place.

In view of the remedial work required before the highway could be opened to the traffic and in view of the significant continuous maintenance required to keep the highway open, it appears, in this instance, that FHWA did not adequately meet this responsibility.

CHAPTER 3

AGENCY COMMENTS AND OUR EVALUATION

The Department of Transportation commented on our draft report in a letter dated December 9, 1971. In summarizing its comments, DOT stated that:

"*** there were extremely adverse field conditions encountered in construction of the projects selected by the GAO for review. These conditions caused some expensive overruns in cost, required much readjustment of contractor's operations, required redesign in some areas, required acquisition of additional right-of-way, and called for a high degree of professional expertise in the field to make engineering decisions on a day-to-day basis. We do not agree that the adverse field conditions can be attributed to inadequate plan review or lack of FHWA field review. There is no real reason to believe that not adjusting time immediately was a factor in increasing the cost of these projects. The extra maintenance now required on the projects is not excessive; it is the least expensive choice to the public considering other possible alternatives."

We did not intend to imply that all the adverse field conditions were attributed to an inadequate plan review and a lack of field review by FHWA. As noted in the report, however, we believe that many of the problems encountered might have been avoided or minimized if FHWA had made a more thorough review of the project plans and had made more thorough and timely field reviews.

DOT agreed, however, to bring the report to the attention of its division offices.

DOT reduced the findings and conclusions in our draft report to several points. DOT's comments on these points and our evaluations of these comments are set forth below.

AN UNREALISTIC DATE WAS ESTABLISHED
FOR OPENING THE HIGHWAY TO TRAFFIC

DOT stated, in part, that:

"It is stated in the report that the opening date of the three I-71 projects reviewed was established by an expediting group rather than by the normal practice of the State highway department. In this connection, it should be recognized that the expediting group was composed primarily of Ohio Department of Highway personnel. Furthermore, the chairman of the committee was also chairman of the Ohio Turnpike Commission, who had been closely involved with the construction and operation of this major highway. The establishment of the target dates for the I-71 work is considered to have been determined by the highest level of State highway administration officials who had complete knowledge of the work involved and of the need for the highway facility.

"Although the comments pertaining to an unrealistic date involve all three State projects, most of the conclusions appear to be based primarily on State Project 79. During the design phase of this project, the consultant engineers involved in the design requested two independent contractors to review the project as to time for accomplishment. These contractors agreed that the time set to open I-71 to traffic was reasonable."

We recognize that the expediting group included persons from the State highway department and that these persons may have had knowledge of the work involved and of the need for the highway. The setting of the opening date by this group is used in the report to illustrate that normal procedures were not followed in establishing the opening date.

Many of the conclusions in the report do apply to project 79. This was the most complex of all the projects, and its completion was essential to opening the highway from downtown Cleveland to the suburbs where the highway was already completed. At the time the opening date was established--April 1963--many of the facts which were necessary

to establish such a date were not known. For example, as noted in the report, the exact location of the highway was not known. As a result many factors necessary for determining a contract date were not known or had not been decided, such as (1) the necessity of building part of the highway as a double-deck bridge, rather than placing the traffic lanes beside each other, had not been determined, (2) the importance of, and need for, a detour road had not been established, and (3) the extent of earthwork required was unknown.

With respect to the comments of independent contractors on the reasonableness of the opening date, we noted that one of the contractors had stated that it would be possible, although difficult, to open the highway to traffic by November 1966, provided that a number of conditions were met. The conditions noted by the contractor and the conditions as they existed at the time the construction contracts for project 79 were awarded are listed below.

| <u>Contractor's conditions for meeting opening date</u> | <u>Conditions actually exist- ing at contract award</u> |
|---|--|
| <p>1. Earliest possible contract award in 1965. Contractor should start <u>full-scale operations</u> in April 1965.</p> | <p>1. Construction contracts were awarded April 12, 1965. The contractor was not in a position to start full-scale operations at that time.</p> |
| <p>2. The following steps must be completed by April 1965:</p> <p style="margin-left: 2em;">a. All rights-of-way available.</p> <p style="margin-left: 2em;">b. All building removals to be accomplished.</p> | <p>2. Status:</p> <p style="margin-left: 2em;">a. All rights-of-way were not available by April 1965.</p> <p style="margin-left: 2em;">b. Building removals were included as part of the construction contract, and they had to be removed before full-scale operations could begin.</p> |

- | | |
|---|--|
| <p>c. All utility relocations to be accomplished.</p> <p>d. A detour road to be completed and existing road on right-of-way closed.</p> | <p>c. All utilities were not relocated until May 1966. The relocation of utilities became a major problem during construction.</p> <p>d. Construction of detour road was part of construction contract. Detour road was not completed until August 1965.</p> |
|---|--|

DOT stated also that there were three completion dates included in the construction contract: (1) September 1, 1965, for the construction of a pedestrian bridge adjacent to a school, (2) October 31, 1966, for opening the highway to traffic, and (3) November 30, 1967, for the completion of all work under the contract.

DOT indicated that (1) the date for completion of the pedestrian bridge was reasonable, (2) the date for opening the roadway to traffic coincided with the dates for completion of other I-71 projects and was an attempt to provide a freeway connection to downtown Cleveland, and (3) the contractor could have met the final completion date if construction problems had not occurred.

We recognize that a number of dates and targets for completion were established for various phases of the work and that certain of these dates, such as the date for completion of the pedestrian bridge, may have been attainable if construction problems had not developed. Considering all the circumstances that existed, however, the critical date, October 31, 1966, for opening the roadway to traffic did not appear realistic when the construction contract was awarded.

CONSTRUCTION PLANS WERE NOT
ADEQUATELY REVIEWED

DOT stated that:

"It is indicated in the report that in an effort to expedite construction of the I-71 highway projects, consulting engineering services were accelerated and requirements for reports on the resolution of all major design questions prior to preparation of detailed construction plans were eliminated.

"There is no indication that any consultant work was shortened. It was accelerated to the extent that efforts were concentrated on the I-71 projects. The only item eliminated from the consultant's work was the publication of the design report. The design report relates to establishment of the alignment, grade, typical cross-section, location of access ramps, interchange designs, determination of right-of-way requirements, etc. All essential elements of the design report were completed, and only the formal printing of the design report was eliminated. This procedure is not unusual. The important point is that all matters normally included in the design report were covered as the preliminary design developed, and each is documented in the project files. Publishing a formal design report would have served little purpose."

The design report, which is required by FHWA, is intended to bring together all major design features of a highway project. The report provides for a review of a project and permits reviewers to comprehensively examine into the plans. As noted in the report, the adequacy of the plans, especially as they relate to the structures to be constructed, became a central issue in certain construction problems encountered.

The requirement that the report be published should be of concern to FHWA, if it questions the usefulness of the report. Publication is a general FHWA requirement for all

Federal-aid highway projects, and it is quite expensive. For example, Project 79 costs were reduced by \$10,000 and project 222 costs were reduced by \$14,500, because publication of the report was not required.

With respect to the adequacy of FHWA's review of the construction plans, DOT stated that FHWA was actively engaged in the design of a highway project throughout the life of the project and that, when the construction plans were submitted by the State for approval, only a limited time was required to check the plans to ensure that they were in accord with all the agreements reached during the design stage. DOT made reference to numerous pieces of correspondence between the State and FHWA and between the offices within FHWA, which indicated the extent of FHWA's review of the plans during the design stage.

We are aware of the numerous pieces of correspondence generated by this large and complex project. We noted, however, that, even though FHWA was actively involved in the design of this, as well as other projects, the plans submitted by the State and approved by FHWA were not always adequate. For example, in a letter dated April 15, 1965, the FHWA Division Engineer informed the Director, Ohio Department of Highways, that the State needed to improve the quality of the plans, specifications, and cost estimates submitted to FHWA for approval. The Division Engineer specifically referred to the plans which FHWA had approved for I-71 projects in the Cleveland area, stating that:

"We have cooperated with you on the many important projects on I-71, particularly in the Cleveland area when the plans required a greater degree of refinement than was indicated by their status on the date of our authorization."

In addition, as noted in the report, FHWA division officials informed us during our review that they had not done an adequate job of reviewing the project plans because of the heavy work load involved and the efforts to expedite the projects.

COMPLIANCE WITH CONSTRUCTION PLANS
WAS NOT REQUIRED, AND CONTRACTOR
WAS AUTHORIZED OR PERMITTED TO USE
OTHER-THAN-NORMAL CONSTRUCTION METHODS

DOT stated that:

"This statement in the report is premised on (a) construction of piers 10 through 18 prior to construction of the 30-foot embankment and (b) construction of embankment during winter months.

"The first point (a) involves interpretation of Plan Note 6, concerning sequence of construction for piers set in embankment material. The State considers there was no violation of plan provisions in starting foundation work on piers 10 through 18 prior to embankment construction. FHWA has carefully reviewed all facts and has agreed that the construction operations were performed in the manner intended by the State and in substantial conformity with the plans for the project. The draft report indicated that it was unclear to GAO how FHWA could have concluded that the construction operations were performed in the manner intended by the State when the State's bridge engineer had specifically instructed its consulting engineers that the plans show that the embankment was to be completed prior to erection of the piers.

"The fact that should be examined is whether the contractor has complied with the plans and specifications. Plan Note 6 has been interpreted by the State and FHWA that it did not mean that the contractor had to construct the embankment before the piers. The note indicated on the plans was interpreted to ensure that the substructure units rest on well compacted embankment rather than as a precaution against movement from consolidation. In approving the construction plans and schedule, FHWA relied on the consultant's report and his experience in the field of foundation engineering. It should be stressed that damages did not occur

from foundation shear failures, but rather seems to have resulted from the consolidation phenomenon."

* * * * *

"The second point (b) is premised on an understanding by GAO that 'State specifications provide generally that embankment work be done in the summer because of problems associated with building embankments in the winter.' (See page 30--draft report.) It is true that there are certain problems associated with winter embankment construction such as prohibitions against using frozen material or placing embankment on frozen grade. There could also be difficulties in using high moisture content materials because of the slow drying rate in winter. But the specifications do not prohibit winter construction of embankments; they describe the conditions under which it can be done. Winter embankment construction is not considered poor engineering practice if done with suitable materials and in conformance with specified requirements."

The controversy over the interpretation of the plan note, as discussed above, is set forth in the report. We believe, however, that the FHWA Regional Administrator's opinion on the interpretation of the plan note is clear and points out that the construction method followed involved some risk. As noted in the report, the Regional Administrator stated that the note was self-explanatory and that good construction procedure dictated the placement of an embankment prior to erecting piers. He pointed out that the piers were not designed to take a horizontal load, such as that caused by the movement of the subsoil beneath the embankment, and that it should have been obvious that the construction procedure followed was not sound. The consultants upon whose report FHWA relied also were of the opinion that normal construction procedures had not been followed in this case.

With regard to the construction of embankments in the winter, we have not suggested that this procedure is

prohibited or that it constitutes poor engineering practice. Our comments are directed toward the costliness of the construction of the embankments in the winter in an effort to expedite construction of the highway.

DOT pointed out that the embankment was not constructed in the fall of 1965 due to the high moisture content of the material and not for the reasons listed in this report. The high moisture content of the material encountered also may have been a problem. The record shows, however, that the embankment could not be completed at that time because unstable material (peat) had to be excavated and that a landslide in the embankment area had delayed the relocation of utility lines through the embankment.

In further commenting on the construction of embankments during the winter DOT stated:

"The draft report indicates that the State, with FHWA approval, authorized the contractor to purchase borrow material suitable for winter use and to construct the embankment during the winter in an attempt to adhere to the October 1966 opening date. FHWA has not approved the change order providing for the borrow primarily because of the question of material removed from the project or used for other than embankment purposes possibly being suitable for embankment purposes."

The record shows that FHWA did approve the State plan to purchase the material. FHWA has not agreed to the amount of Federal participation that may be allowed in the costs associated with the use of the borrow material, pending resolution of certain questions dealing with earthwork operations elsewhere on the project. As previously noted, FHWA's participation in the costs related to this work appears contrary to its general policy of not sharing in the additional costs associated with expediting construction.

FHWA FAILED TO REQUIRE THE STATE TO ADJUST
OPENING DATE SPECIFIED IN CONTRACT
WHEN DIFFICULTIES WERE ENCOUNTERED THAT
OBVIOUSLY WOULD DELAY OPENING OF HIGHWAY

DOT stated that the practice of not adjusting the contract dates when construction delays were encountered had been a normal practice for some time on all projects in Ohio. DOT stated also that there was no reason to believe that the failure to adjust the contract dates on a timely basis had contributed to extra expense and that the contractors were under no contractual compulsion to make up lost time. DOT pointed out that, because the expediting group worked closely with the contractors in scheduling work as the delays occurred, delays undoubtedly were minimized and, to that extent, extra-cost claims were minimized.

The fact that Ohio, for some time, has been following the practice of not adjusting contract dates as delays are encountered does not justify such a practice. As previously pointed out, because the opening date was not adjusted, the contractor used other-than-normal construction methods in an attempt to meet the opening date. The methods used and the problems encountered increased project costs considerably.

In addition, because the contract dates were not adjusted, the contractors were under a contractual compulsion to make up lost time. We noted several instances where the contractors had requested extensions of time. In denying the time extensions, the expediting group reminded the contractors that they must meet the October 1966 opening date. In one instance the expediting group requested one contractor on project 222 to prepare a revised construction schedule showing the opening of the highway by the contract date. The contractor replied, in part, that:

"Of necessity we have shown the I-71 portion open on October 31, 1966, though such is an ambitious plan. This, we repeat is in answer to your requests, but constitutes no guarantee."

The contractor also listed several reasons for the slippage in the construction schedule. Two of the reasons listed by the contractor were the late relocation of utilities and the late release of certain right-of-way parcels, both of which interfered with the orderly progress of the work. The contractor for project 79 also enumerated the causes of delays to that project. He stated that two of the major delays experienced involved the relocation of a gas main and a water main. The contractor further stated that these two items had a significant impact on other critical items of work.

These instances clearly show that the contractors were under a contractual compulsion to meet the opening date even though meeting the date was unrealistic.

We believe that, had the State adjusted the opening date because of the early problems encountered, many of the later problems possibly could have been avoided and project costs could have been lower.

DOT stated that the FHWA Division Office recently had advised Ohio that in the future any time extensions due to changed conditions must be submitted concurrently with the change order covering the work in question.

SIGNIFICANT MAINTENANCE PROBLEM
HAS BEEN CREATED DUE TO METHODS AND PROCEDURES
USED BY STATE AND PERMITTED BY FHWA

DOT stated that our conclusion on this point apparently was premised on the necessity for placing monitoring devices on project 79 to maintain a continuous check on the stability of part of the highway because significant maintenance had been required on project 222 after the highway was opened to traffic. These are the reasons which premised our conclusion.

DOT also commented on the adequacy of the procedures used to take soil boring of the landfill area on project 222 and stated that the State should have been credited for knowing that the landfill existed. We are not critical of the soil boring procedures followed, and we believe that this report fully recognizes that the State knew the

landfill existed. Our criticism is directed toward the decision to build over the landfill, rather than remove it, in an effort to expedite construction.

DOT stated that:

"The State's decision to construct Project 222 on the remaining landfill, after removing 3 feet below plan elevation, was a calculated risk in the interest of economy. When the condition was discovered in the construction stage, the State made an analysis to establish a course of action. Our office had no objection to the method used to resolve the problem. In cases of this kind, it is not reasonable for FHWA to attempt to substitute its engineering judgment for that of the State unless the course of State action is clearly irresponsible and likely to result in a hazardous condition.

"This instance would have required complete removal of an additional 25-foot depth of landfill to have assured a stable embankment. The cost would have been very high. Alternatively, the fill could have been built with an added surcharge and left to set for a year or more before surcharge removal and paving. This alternate would have denied the public the use of the facility while the settlement took place under the surcharge.

"We cannot fault the State's decision in this case; the fill has required periodic maintenance, but it has carried traffic and it is stabilizing. When settlement ceases, the roadway will be put in plan condition and the cost to the public will be less than either of the other alternatives."

The roadway had not stabilized, and as pointed out on page 23, there is some question whether it ever will completely stabilize. We believe, therefore, that there can be no basis for determining whether the procedure followed was the most economical.

OTHER MATTERS

In commenting on the delays encountered because of the nonavailability of all the necessary rights-of-way and the late relocation of utilities, DOT stated that there had been no delay because some of the rights-of-way were not available at the time the construction contracts were awarded and that in most major urban highway projects all utility relocation could not be completed prior to the award of construction contracts because utility adjustments had not been coordinated with the contractors' operations.

The project records show that the nonavailability of all rights-of-way and the late relocation of utilities caused some of the construction problems. One contractor stated that these problems had interfered with the orderly progress of the work. The contractor's claims resulting from delays showed that two of the reasons given for the delays were the late release of all rights-of-way and the late relocation of utilities.

DOT pointed out that there was no requirement for completion of the detour road in the construction contract and that there was no mention made in any of FHWA's reports regarding delay to the project due to the detour road's not being completed prior to August 1965. According to DOT there were many areas of construction available to the contractor prior to the completion of the detour construction.

We recognize that the record does not show any delay on the project because the detour road was not constructed by April 1965. We noted, however, that the purpose of the detour road was to enable the contractor to close the existing highway, which carried a heavy volume of traffic, so that I-71 could be built on that location. Because the existing highway could not be closed, the contractor had to work in other areas. Difficulties were encountered, however, in those areas as the contractor proceeded. It seems obvious, therefore, that the completion of the detour road affected the progress of the construction.

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CHAPTER 4

SCOPE OF REVIEW

We conducted our review at the Ohio State Highway Department offices and the FHWA division offices in Columbus. We also visited the location of the highway in Cleveland, the project consulting engineers in Cleveland, and one of the contractor's offices in Chicago, Illinois.

We reviewed pertinent FHWA policies and procedures, held discussions with appropriate officials, and reviewed records of the FHWA Ohio Division Office, the FHWA headquarters office in Washington, D.C., and the Ohio State Highway Department. We also reviewed pertinent correspondence and records of the expediting group established by the State of Ohio.



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

December 9, 1971

ASSISTANT SECRETARY
FOR ADMINISTRATION

Mr. Richard W. Kelley
Assistant Director, Civil Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Kelley:

Your letter of July 20, 1971, requests comments on the GAO draft report entitled "Administration and Control over the Construction of Sections of I-71 in Ohio not Effective."

The GAO report concerned two sections of I-71 in the city of Cleveland. These two sections were divided into three projects numbered 79 (I-71-5(33)244, I-80-4(20)164, and US-1463(2)); 222 (I-71-5(19)249); and 27 (I-71-5(31)248).

The report contends that the State of Ohio and the Federal Highway Administration, in an attempt to adhere to an unrealistic date for opening sections of I-71 to traffic, did not require compliance with the construction plans; authorized or permitted the use of other than normal construction methods and the construction of embankments in the winter in an attempt to expedite the construction of the highway; and failed to require the State to adjust the opening date specified in the contract when difficulties were encountered which would obviously delay opening of the highway to traffic. Furthermore, it is indicated that a significant maintenance problem has resulted since the highway was opened to traffic, as evidenced by the State's action to place monitoring devices on one project to maintain a continuous check on the stability of certain construction.

The GAO recommends that FHWA bring the report to the attention of its division offices for purposes of emphasizing the importance of making thorough reviews of project plans and specifications and effective inspections of projects in an effort to preclude the recurrence of similar situations.

The findings and conclusions in the report have been reviewed by this office and we find these essentially reduced to five points, as follows:

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1. An unrealistic date was established for opening the highway to traffic.

As indicated in the report, construction periods and completion dates for highway projects are established by the State highway department. Where Federal-aid highway funds are involved, the construction periods and completion dates as they pertain to highway contracts are reviewed by the FHWA division office for reasonableness and are approved as part of the State's plans, specifications and estimates submission.

It is stated in the report that the opening date of the three I-71 projects reviewed was established by an expediting group rather than by the normal practice of the State highway department. In this connection, it should be recognized that the expediting group was composed primarily of Ohio Department of Highway personnel. Furthermore, the chairman of the committee was also chairman of the Ohio Turnpike Commission, who had been closely involved with the construction and operation of this major highway. The establishment of the target dates for the I-71 work is considered to have been determined by the highest level of State highway administration officials who had complete knowledge of the work involved and of the need for the highway facility.

Although the comments pertaining to an unrealistic date involve all three State projects, most of the conclusions appear to be based primarily on State Project 79. During the design phase of this project, the consultant engineers involved in the design requested two independent contractors to review the project as to time for accomplishment. These contractors agreed that the time set to open I-71 to traffic was reasonable.

There were three completion dates involved on State Project 79. The first was for the completion of the Buhrer Avenue pedestrian bridge adjacent to Buhrer School by September 1, 1965. Since the contract was let on April 6, 1965, this meant the contractor had approximately 4 summer months to construct the rather simple bridge.

The second completion date required the contractor to complete I-71 lanes and structures sufficient to maintain two lanes of traffic in each direction by October 31, 1966. The time set for providing service through this project coincided with other I-71 project completion dates and was an attempt to provide a freeway connection to downtown Cleveland and I-90.

Interstate 90 was already completed east to the Pennsylvania line and I-71 extended across the State from Cincinnati to the suburbs

of Cleveland. Had the contract provided for the completion of all work on I-71 by October 31, 1966, the completion date might have been questionable. In view of the limited completion required, it appears the contractor could have met the date if the various problems, later to be experienced, had not occurred.

All work was set for completion on November 30, 1967. This date, therefore, allowed three construction seasons and two winter periods to complete a \$14 million project. This compares favorably with time allowed on other projects of this size, and FHWA believes the time allowed was appropriate, especially when evaluated with the tremendous service the new facility would open up to the public use.

Accordingly, we believe there was little reason to question the scheduled opening date of project 79. Even today, it appears that that date and the completion dates established for the other projects would have been met had the unforeseen construction problems not developed.

2. Construction plans were not adequately reviewed.

It is indicated in the report that in an effort to expedite construction of the I-71 highway projects, consulting engineering services were accelerated and requirements for reports on the resolution of all major design questions prior to preparation of detailed construction plans were eliminated.

There is no indication that any consultant work was shortened. It was accelerated to the extent that efforts were concentrated on the I-71 projects. The only item eliminated from the consultant's work was the publication of the design report. The design report relates to establishment of the alignment, grade, typical cross-section, location of access ramps, interchange designs, determination of right-of-way requirements, etc. All essential elements of the design report were completed, and only the formal printing of the design report was eliminated. This procedure is not unusual. The important point is that all matters normally included in the design report were covered as the preliminary design developed, and each is documented in the project files. Publishing a formal design report would have served little purpose.

[See GAO note.]

GAO note: Comments pertaining to draft report material revised in final report have been omitted.

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[See GAO note.]

The GAO report points out that at the time the individual contracts were awarded in March, April and June 1965, some rights-of-way had not been acquired and necessary utility relocations had not been completed. Furthermore, in addition to completion of State Project 79 on time, a detour road to carry existing traffic around the construction site had to be completed by April 1965. The report indicates that the construction of the detour road was not completed until August 1965, about 4 months later than required and about two-thirds of the way into the construction season.

Parcels of right-of-way not available to the contractors at the time the projects were let were detailed in the bidding proposals. The effect these parcels would have on the projects was analyzed before the lettings. The parcels on State Projects 27 and 79 were not considered critical. Four parcels on State Project 222 were considered critical but were to be available within about 2 weeks after work started. Records indicate there was no delay because of right-of-way unavailability.

With regard to utilities, as on any urban project all utility work could not be done prior to letting of the contract because the utilities had to be adjusted in coordination with the contractors' operations. The bidding documents for each project advised the contractors what work remained to be done. The right-of-way and utility status on these three I-71 projects at the time of letting were not exceptional in comparison with other major urban projects.

There was no requirement for completion of the detour road set by the contract. The contract was awarded April 12, 1965, and work began May 3, 1965. The detour could not be completed in April since it was a part of the construction plan. The contractor's completion of the detour in August appears to indicate a reasonable effort, and there is no mention made in any of FHWA's reports regarding delay to the project due to its not being completed prior to that time. There were many areas of construction available to the contractor prior to completion of the detour construction.

The report states that FHWA officials advised them that because of the heavy workload and the expedited nature of the three I-71

GAO note: Comments pertaining to draft report material revised in final report have been omitted.

projects, sufficient time was not available to perform an adequate review of the plans, and greater reliance was therefore placed on the State's review. It should be recognized that FHWA is actively engaged in the design of a highway project throughout the life of the design. When the plans, specifications, and cost estimate come to FHWA, only a limited time is required to check the plans to assure that they are in accord with all of the agreements reached during the design stage.

The adequacy of FHWA reviews which resulted in such agreements is evidenced by the division files for State Project 79 which contain the following items of correspondence pertaining to the design of this project: 38 letters from the State, 35 letters to the State, 11 memorandums to Region, 6 memorandums from the Region, and 12 office memorandums. Many of the State's submissions included plans of various phases of the work. In addition, at least 15 meetings were held to discuss various items of the design. FHWA's letters to the State concerning the review of the plans, specifications, and estimate include some 22 comments concerning various phases of the work. There are no indications that FHWA's involvement in the development of the plans or review of the plans was less than adequate.

3. Compliance with construction plans was not required and contractor was authorized or permitted to use other than normal construction methods.

This statement in the report is premised on (a) construction of piers 10 through 18 prior to construction of the 30-foot embankment and (b) construction of embankment during winter months.

The first point (a) involves interpretation of Plan Note 6, concerning sequence of construction for piers set in embankment material. The State considers there was no violation of plan provisions in starting foundation work on piers 10 through 18 prior to embankment construction. FHWA has carefully reviewed all facts and has agreed that the construction operations were performed in the manner intended by the State and in substantial conformity with the plans for the project. The draft report indicated that it was unclear to GAO how FHWA could have concluded that the construction operations were performed in the manner intended by the State when the State's bridge engineer had specifically instructed its consulting engineers that the plans show that the embankment was to be completed prior to erection of the piers.

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The fact that should be examined is whether the contractor has complied with the plans and specifications. Plan Note 6 has been interpreted by the State and FHWA that it did not mean that the contractor had to construct the embankment before the piers. The note indicated on the plans was interpreted to ensure that the substructure units rest on well compacted embankment rather than as a precaution against movement from consolidation. In approving the construction plans and schedule, FHWA relied on the consultant's report and his experience in the field of foundation engineering. It should be stressed that damages did not occur from foundation shear failures, but rather seems to have resulted from the consolidation phenomenon.

[See GAO note.]

The second point (b) is premised on an understanding by GAO that "State specifications provide generally that embankment work be done in the summer because of problems associated with building embankments in the winter." (See page 30--draft report.) It is true that there are certain problems associated with winter embankment construction such as prohibitions against using frozen material or placing embankment on frozen grade. There could also be difficulties in using high moisture content materials because of the slow drying rate in winter. But the specifications do not prohibit winter construction of embankments; they describe the conditions under which it can be done. Winter embankment construction is not considered poor engineering practice if done with suitable materials and in conformance with specified requirements.

We would like to point out at this time that the embankment in question on State Project 79 (page 30--draft report) was not completed in the fall of 1965 due to the amount of high moisture content material encountered on the project and not for the reasons listed in the GAO report.

The draft report indicates that the State, with FHWA approval, authorized the contractor to purchase borrow material suitable for winter use and to construct the embankment during the winter in an attempt to adhere to the October 1966 opening date. FHWA has not approved the change order providing for the borrow primarily because of the question of material removed from the project or used for other than embankment purposes possibly being suitable for embankment purposes.

GAO note: Comments pertaining to draft report material revised in final report have been omitted.

4. FHWA failed to require the State to adjust the opening date specified in the contract when difficulties were encountered which would obviously delay the opening of the highway.

The report contends that failure to adjust contract time on these projects when construction delays occurred was an unusual practice and led to extra costs. In Ohio this has been normal practice for some time on all jobs. There is no reason to believe that failure to adjust contract time on a timely (immediate) basis for this construction contributed to extra expense. The State was aware of the delay, and the contractor understood his rights to claim extra time, so there was no contractual compulsion to make up lost time.

The expediting group did work closely with the contractor as construction sequences and schedules had to be adjusted to meet time-consuming delays caused by adverse field conditions. Every effort was made to keep contractor's forces and equipment employed in prosecution of the work wherever conditions would permit, even though at times working at reduced efficiency because of restrictions imposed by changed field conditions. These efforts undoubtedly kept the delays to a minimum and to that extent minimized extra cost claims.

The FHWA requirements concerning contract time are contained in Policy and Procedure Memorandum 21-6.3, paragraph 19b. The PPM reads:

At the time such conditions occur, or as soon thereafter as it is practicable to make a determination, agreement should be reached between FHWA (formerly Bureau of Public Roads) and the State as to any adjustments in contract time that may be appropriate on account thereof.

In this case, the contractors experienced several delays and the time extensions were not processed until late in the project when the overall effects could be determined. The Ohio Division Office has recently advised the State that any time extension due to changed conditions must be submitted concurrently with the change order covering the work in question.

5. A significant maintenance problem has been created due to methods and procedures used by the State and permitted by FHWA.

Comments pertaining to this item are related to the construction of a 30-foot embankment on State Project 79 and the construction of the roadway over a landfill on State Project 222. The draft report has

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indicated that FHWA did not adequately meet the responsibility of ensuring that the State construct sound, durable, and adequate highways. This conclusion was apparently premised on the necessity for placing monitoring devices on State Project 79 to maintain a continuous check on the stability of part of the highway and the performance of significant maintenance work on State Project 222 since the highway was opened to traffic.

The monitoring devices placed on State Project 79 were installed to help analyze the pier movement problem and not for the purpose of a continuous check on the sidehill stability. The exact cause of the pier failure was never established. The statement that the damage to the piers was caused by the consolidation of the subsoil is just a theory of what is considered to have happened. Studies performed by the State and its consultant and FHWA indicated that there were no stability problems in the sidehill. An up-to-date report by the consultant in October 1970 indicated that there is still no problem.

The draft report is also critical of the procedures utilized for the construction of a highway over a landfill. A point of concern appears to be that the borings taken before construction began did not show the full depth of the landfill because they did not penetrate through the landfill to the ground below. The report implies that if the full depth had been discovered early enough, it could have been taken into consideration in formulating the original design.

[See GAO note.]

We do not believe the State or FHWA was irresponsible in their efforts to ensure a sound investment of Federal funds as implied in the GAO draft report. The statement by GAO concerning the fact that borings taken during the preliminary design did not penetrate the full depth of the landfill needs clarification. We believe this statement was made as a result of an "after-the-fact" condition. There were a series of auger borings that were taken in the landfill area during the design stage. All of these borings were driven down to points of refusal in the landfill. The number and frequency of these auger borings were to such an extent that we could have reasonably expected the State to have had adequate information on which to base design decisions.

GAO note: Comments pertaining to draft report material deleted from this final report have been omitted.

In the case of landfills, a point of refusal would not necessarily mean the auger boring went down to a solid natural strata since encountering a hard object in the fill would have produced the same effect. However, with the number of auger borings actually taken, we would expect that some of these borings would have penetrated through the landfill and would have provided the State with sufficient information concerning the volume and condition of existing material. The State should be credited with the fact that they knew a landfill existed since a plan note provided that all this material was to be removed.

Under our Federal-aid procedures, the State is responsible for the design and construction of highways on the Federal-aid system. FHWA's position is to review the State's design and construction activities to ensure proper expenditure of Federal funds. It is not intended that our field office review these activities to the same extent as the State due to manpower limitations. Our review of any proposed highway is not a one-time situation. We are actively involved in a highway project from the initial location phases to the time the project is in the maintenance stage. In administering the Federal-aid program, FHWA assures that the State has procedures in effect which should produce satisfactory design, construction and maintenance operations by the issuance of policies and directives and by monitoring the different activities of the State. Detailed review of the State's design, construction and maintenance activities is made by our field personnel on a selective basis. As noted above, our review indicated no basis on which to question the adequacy of the soil borings or the State's interpretation of them.

The State's decision to construct Project 222 on the remaining landfill, after removing 3 feet below plan elevation, was a calculated risk in the interest of economy. When the condition was discovered in the construction stage, the State made an analysis to establish a course of action. Our office had no objection to the method used to resolve the problem. In cases of this kind, it is not reasonable for FHWA to attempt to substitute its engineering judgment for that of the State unless the course of State action is clearly irresponsible and likely to result in a hazardous condition.

This instance would have required complete removal of an additional 25-foot depth of landfill to have assured a stable embankment. The cost would have been very high. Alternatively, the fill could have been built with an added surcharge and left to set for a year or more before surcharge removal and paving. This alternate would have denied the public the use of the facility while the settlement took place under the surcharge.

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We cannot fault the State's decision in this case; the fill has required periodic maintenance, but it has carried traffic and it is stabilizing. When settlement ceases, the roadway will be put in plan condition and the cost to the public will be less than either of the other alternatives.

Summary

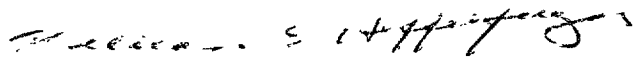
In summary, there were extremely adverse field conditions encountered in construction of the projects selected by the GAO for review. These conditions caused some expensive overruns in cost, required much readjustment of contractor's operations, required redesign in some areas, required acquisition of additional right-of-way, and called for a high degree of professional expertise in the field to make engineering decisions on a day-to-day basis. We do not agree that the adverse field conditions can be attributed to inadequate plan review or lack of FHWA field review. There is no real reason to believe that not adjusting time immediately was a factor in increasing the cost of these projects. The extra maintenance now required on the projects is not excessive; it is the least expensive choice to the public considering other possible alternatives.

Conclusion

FHWA has currently in effect various policy and procedure directives which, in our opinion, adequately emphasize the importance of thorough reviews of project plans and specifications and effective administration of construction projects. As recommended FHWA will distribute the final GAO report on this subject to its field offices.

Thank you for the opportunity to comment on your report.

Sincerely,



William S. Heffelfinger

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