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Report to Secretary, Department of Transportation; by Henry Eschwege, Director, Community and Economic Development Div.

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The Federal Highway Administration has expressed concern about construction zone safety for over 11 years, but this concern has not always been reflected in the safety provisions made by State highway agencies.

Findings/Conclusions: Unsafe conditions existed at all of the 26 construction sites visited in 7 States. Designs for worksite safety varied widely from State to State and from project to project. Although the Highway Administration has taken some actions to improve driving environments, these actions do not fully address the problems observed. By developing additional guidance on how and when to use traffic control devices, by improving field office inspection procedures, and by providing training, the Highway Administration and the States can greatly improve the safety of motorists, pedestrians, and work crews in highway construction zones.

Recommendations: The Secretary of Transportation should: direct the Administrator of the Federal Highway Administration to revise the Manual on Uniform Traffic Control Devices to include specific guidance on how and when to use traffic control devices in construction zones; require training to help insure that Federal and State officials are made aware of the importance of construction zone safety and have the capability to plan for, implement, and inspect these safety measures; and establish field office inspection procedures to identify hazardous conditions and insure that they are corrected. (Author/SC)



*UNITED STATES
GENERAL ACCOUNTING OFFICE*

Highway Construction Zone Safety--Not Yet Achieved

The Highway Administration has expressed concern about construction zone safety for over 11 years, but this concern was not always reflected in the safety provisions made by State highway agencies. At all of the 26 construction sites GAO visited, unsafe conditions existed. GAO found that designs for worksite safety varied widely from State to State and project to project. Although the Highway Administration has taken some actions to improve driving environments, these actions do not fully address the problems GAO found.

Accordingly, the Federal Highway Administration needs to develop additional program guidance, provide and promote more training, and strengthen the inspection procedures of its field offices.



UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

COMMUNITY AND ECONOMIC
DEVELOPMENT DIVISION

B-164497(3)

The Honorable
The Secretary of Transportation

Dear Mr. Secretary:

We have reviewed the efforts being made by the Federal Highway Administration to increase safety in highway construction zones. This report presents the results of that review.

Our report contains several recommendations to you which, if implemented, will improve the safety environment on future Federal-aid highway projects. The report was discussed with Federal Highway Administration program officials, and their comments were considered in preparing the report.

As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

Copies of this report are being sent to the House and Senate Committees on Appropriations; the House Committee on Public Works and Transportation; the Senate Committee on Environment and Public Works; the House Committee on Government Operations; the Senate Committee on Governmental Affairs; and the Acting Director, Office of Management and Budget.

Sincerely yours,

A handwritten signature in cursive script that reads "Henry Eschwege".

Henry Eschwege
Director

D I G E S T

Because highway accident rates are higher in construction zones, it is important that States take special efforts at these worksites to protect motorists, pedestrians, and work crews. (See p. 1.)

The Federal Highway Administration has been emphasizing safety in highway construction zones since 1966. However, the hazards GAO found indicated that in 11 years this emphasis has not always reached responsible project level officials at Highway Administration field offices and State highway agencies.

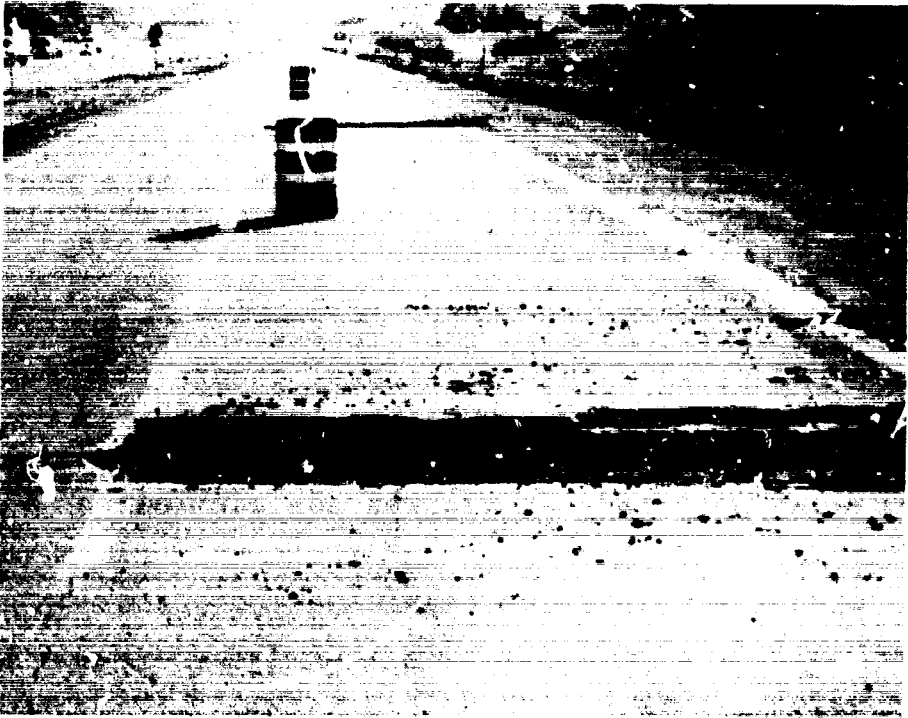
When designing, implementing, and inspecting highway worksites, these project officials have not been devoting enough attention to safety. GAO believes this occurred because they did not always know how to make worksites safe, did not adequately appreciate the need for safety in construction zones, or placed higher priority on other matters, such as construction quality.

Accordingly, the Federal Highway Administration needs to develop additional program guidance, provide and promote more training, and strengthen the inspection procedures of its field offices. (See p. 4.)

Since the early 1970s States have been using increasingly larger portions of their Federal-aid funds for rebuilding highways.

GAO's review of construction zone safety in seven States--Louisiana, Mississippi, Missouri, New York, Ohio, Texas, and Washington--revealed widely varying safety deficiencies at the 26 sites visited.

The following photograph shows one of the problems found.



A series of 1-foot-deep pavement cutouts extending across the centerline were marked by positioning drums between the hazards instead of next to them. At night, a motorist may not notice the dropoff because his attention is on the barrels. This could be dangerous if he leaves the left lane and drives between the barrels. Other safety hazards are shown on pages 5 to 12.

Although the States or local jurisdictions managing Federal-aid highway reconstruction are responsible for assuring safety, the Federal Government has an overview responsibility.

The Highway Administration has recognized problems in achieving safe construction zones. It has proposed regulations to insure that States address the potential hazards at each worksite, has undertaken research, has developed and sponsored training programs, and is working to

upgrade its manual of acceptable traffic control devices. (See p. 10.)

These actions, however, do not fully address all the problems GAO found. (See p. 21.)

The Highway Administration's Manual on Uniform Traffic Control Devices describes devices that can be used in construction zones. It does not contain enough information on how and when these devices should be used. Until uniform standards for using these devices are established, State planners, project officials, and Federal inspectors will not have sufficient guidelines for safe highway worksites. (See p. 15.)

Highway Administration field offices have not developed procedures describing the scope and frequency of inspections, nor have State and Federal officials been adequately inspecting the safety of construction zones. Federal officials attributed these failures to competing time requirements and lack of knowledge. They regard construction zone safety as a comparatively lower priority issue. (See p. 19.)

Planners and State and Federal project inspectors need training in construction zone safety techniques. Little has been accomplished by the Highway Administration to satisfy these needs. (See p. 16.)

By developing additional guidance on how and when to use traffic control devices, by improving field office inspection procedures, and by providing training, the Highway Administration and the States can greatly increase the safety of motorists, pedestrians, and work crews. (See p. 21.)

The Secretary of Transportation should direct the Administrator, Federal Highway Administration, to:

- Revise the Manual on Uniform Traffic Control Devices to include specific guidance on how and when to use traffic control devices in construction zones.

--Require training to help insure that Federal and State officials are made aware of the importance of construction zone safety and have the capability to plan for, implement, and inspect these safety measures.

--Establish field office inspection procedures to identify hazardous conditions and insure that they are corrected.

The Federal Highway Administration generally agreed with the GAO recommendations. (See p. 22.)

C o n t e n t s

	<u>Page</u>
DIGEST	i
CHAPTER	
1 INTRODUCTION	1
Importance of construction zone safety	1
Federal-State responsibilities	2
Scope of review	3
2 IMPROVEMENTS NEEDED TO ACHIEVE CONSTRUCTION ZONE SAFETY	4
Highway construction zones are not safe	5
Recent actions to improve management	13
Program guidance inadequate	15
Increased training needed	16
Construction plans need to be strengthened	17
State supervision should be improved	19
Highway Administration monitoring needs to be improved	20
Conclusions	21
Recommendations	22
Agency comments and our evaluation	22
APPENDIX	
I Sites visited during our review	24
II Our observations for three projects visited	25
<u>ABBREVIATIONS</u>	
AASHTO	American Association of State Highway and Transportation Officials
GAO	General Accounting Office

CHAPTER 1

INTRODUCTION

Over the past 21 years, the Federal Government has given States about \$85 billion for constructing and reconstructing Interstate and other Federal-aid highways. Recently, States have been using increasingly larger portions of their Federal-aid funds to preserve and upgrade the initial investment. For example, between fiscal years 1970 and 1975, State obligations of Federal-aid funds for reconstruction increased by 223 percent from about \$560 million to \$1.8 billion. More recent obligational data for fiscal year 1977 showed that almost \$2.3 billion had been used for upgrading--an increase of 27 percent since 1975.

In addition, the Congress has recognized the need to maintain the quality of existing highways. Through the Federal-Aid Highway Act of 1976 (Public Law 94-280), the Congress provided \$175 million annually for fiscal years 1978 and 1979. These funds were specifically for reconstructing--rehabilitating, restoring, and resurfacing--Interstate highways in use over 5 years and not used as toll roads.

As State reconstruction activity increases, increasingly higher volumes of traffic will have to be routed through or around active construction zones. Federal Highway Administration records showed that during fiscal year 1977 about 13,100 miles of existing Federal-aid highways had been under construction. Because these construction zones are potentially hazardous, adequate traffic management techniques must be employed to insure motorist, worker, and pedestrian safety. In addition, generally rising traffic volumes will compound the problems associated with managing traffic in construction zones.

IMPORTANCE OF CONSTRUCTION ZONE SAFETY

Construction zone safety encompasses those activities that provide for safe, expeditious movement of motorists and pedestrians through construction and maintenance zones and for the protection of the work force.

This matter has been a subject of concern in recent years for the Congress, Federal Highway Administration, and organizations concerned with highway safety, such as the National Advisory Committee on Uniform Traffic Control Devices, the National Highway Safety Advisory Committee, the Center for Auto Safety, and the American Association of State Highway and Transportation Officials (AASHTO). A

common belief, supported by numerous reviews, is that meaningful action must be taken to make construction sites safer.

Since more hazards exist during construction, traffic accidents are more likely to occur at that time. While no national statistics are available, several studies support the contention that accident rates are higher in construction zones. One study, based on 1965 statistics of construction zones in California, showed that the overall accident rate increased by 21 percent during construction, whereas the fatal accident rate increased 132 percent. In April 1977, a consulting firm prepared for the Department of Transportation a report entitled "Accident and Speed Studies in Construction Zones." This study covered 79 projects and 20,000 accidents in Colorado, Georgia, Michigan, Minnesota, New York, Ohio, and Washington. Higher accident rates occurred on 69 percent of the projects. Further, in 24 percent of the projects, accident rate increases of 50 percent or more were experienced. Another study of a project in Virginia indicated the overall frequency of accidents increased 119 percent, with fatalities going up by 320 percent. In an Illinois review of two toll roads under construction, researchers reported vehicle crashes increased 160 percent.

FEDERAL-STATE RESPONSIBILITIES

The Highway Safety Act of 1966 (80 Stat. 731) requires each State to have a highway safety improvement program approved by the Secretary of Transportation. The objective of the program is to reduce the deaths, injuries, and property damage caused by traffic accidents on the Nation's highways.

The overall effect of the act was to involve the Federal Government directly in the quality and quantity of State highway safety operations by providing Federal funds and issuing standards and guidelines. Our review focused on Highway Administration and State efforts to protect motorists and pedestrians in highway construction zones, as part of the overall safety improvement program required by the 1966 act.

The Highway Administration is responsible for developing program guidance and approving State highway safety improvement plans and proposed construction projects. In addition, it monitors State performance to assure that Federal standards are met.

The States and local jurisdictions, in designing and constructing individual highway projects, are responsible for assuring that adequate advance warning, guidance, and regulation of traffic are given the motoring public around

these sites. To accomplish this, States are to use Highway Administration program guidance in designing project specifications, inspecting construction sites, and initiating needed changes.

SCOPE OF REVIEW

We reviewed the Highway Administration's guidance for insuring safety in highway construction zones, Federal and State planning procedures and training activities, the adequacy of safety provisions at worksites and Federal and State inspection procedures. We reviewed construction zone safety efforts at the Highway Administration headquarters, Washington, D.C., and at its regional offices in Atlanta, Georgia, and Fort Worth, Texas. We visited its division offices, the respective State highway agencies' central offices and selected field offices in Louisiana, Mississippi, Missouri, New York, Ohio, Texas, and Washington. We interviewed Highway Administration, State highway, or local jurisdiction officials at the 26 projects we visited in the seven States. In addition, we verified the severity of the safety hazards we observed with a representative of a consulting firm that had developed a construction zone safety training course for the Highway Administration.

CHAPTER 2

IMPROVEMENTS NEEDED TO ACHIEVE

CONSTRUCTION ZONE SAFETY

The Highway Administration is responsible for assuring that State highway agencies provide adequate construction zone safety on federally assisted reconstruction projects. Despite the Highway Administration's expressed concern for construction zone safety from 1966 to as recent as September 1976, hazardous conditions were evident at each of the project sites we visited. State and Highway Administration field officials were not giving construction zone safety enough consideration when designing, implementing, and inspecting highway construction projects.

The varying deficiencies we found in State highway agencies' construction zone safety practices indicated that the Highway Administration's interest had not always reached the project level. As a result, motorists, pedestrians, and workers faced hazardous conditions at highway construction projects. In our view, failure to adequately deal with construction zone safety matters occurred because:

- State highway and Highway Administration field officials did not always approach highway construction in a manner that adequately addressed the safety problems motorists encounter in highway construction areas.
- Some officials believed that other matters, such as construction requirements and environmental quality, had higher priority than construction zone safety.
- Highway Administration guidance provided very limited information on how and when to use appropriate traffic control devices.
- State highway and Highway Administration field officials were not adequately training their personnel.

Recently the Highway Administration has developed training courses and initiated a large research effort in this area. It also proposed that the States be required to develop procedures to insure preparation of traffic control plans for each reconstruction project.

These efforts should increase the Federal emphasis on construction zone safety. However, the Highway Administration needs to take additional steps to insure that its emphasis is reflected in safety provisions made by State highway agencies to adequately design, implement, and inspect for safety.

HIGHWAY CONSTRUCTION ZONES ARE NOT SAFE

Using information gained during our participation in a Highway Administration-sponsored training course on construction zone safety, we inspected 26 construction sites in seven States and found unsafe and hazardous conditions at each site. (See app. I for a list of the projects.) Although some States had relatively safe projects, the overall frequency and seriousness of the conditions as illustrated in the following photographs show that the Highway Administration has not been successful in achieving adequate safety in construction zones.

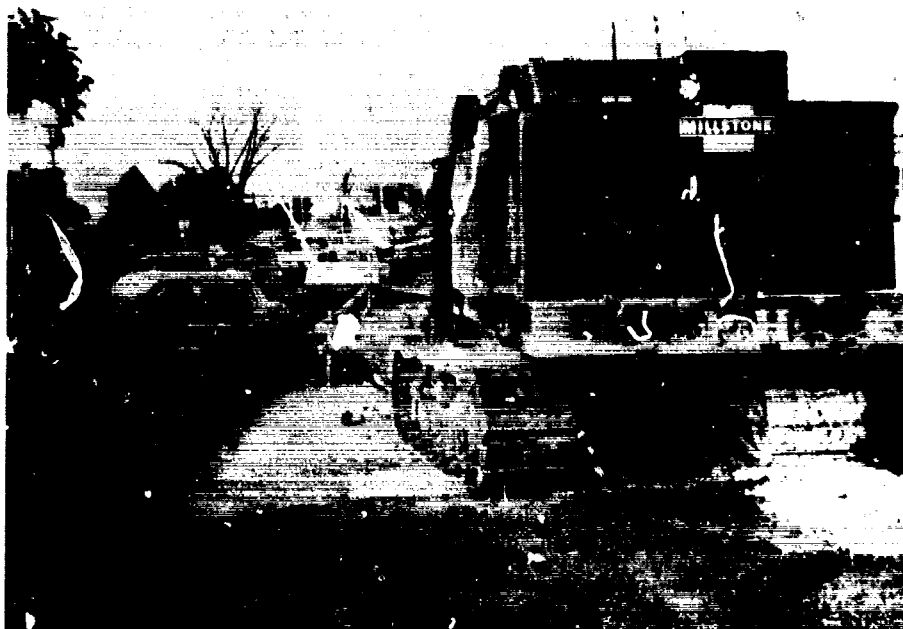
--Pavement dropoffs up to about 7 feet deep were not adequately marked for day or night visibility.



The following photo shows the motorist's view of the excavation pictured on page 5. Red plastic streamers were tacked onto wooden construction forms to warn motorists of the hazard. However, the forms did not adequately mark the hazard because they did not show up well, particularly at night.



--Construction equipment and material were stored close to traffic lanes.



This crane was left on the road shoulder overnight. The equipment's proximity to traffic and poor reflectivity created an extremely hazardous condition. At night, motorists surprised by its presence made erratic maneuvers into the left traffic lane.



The fenced-in area contained various sizes of water and sewage pipes and was flush with the edge of the traffic lane. Lack of reflective markings on the fence caused a hazardous condition at night.

--There were failures to provide for pedestrian traffic.



Pedestrians were forced to walk in a traffic lane to cross the street.

--Large pieces of concrete, sandbags, heavy steel forms, and timbers 12 inches square and 5 or 6 feet long were used to anchor or stabilize drums, barricades, or sign frames. These obstacles could become deadly missiles if struck by a vehicle.



Heavy steel forms were used extensively at one project to anchor metal drums in the manner shown above.

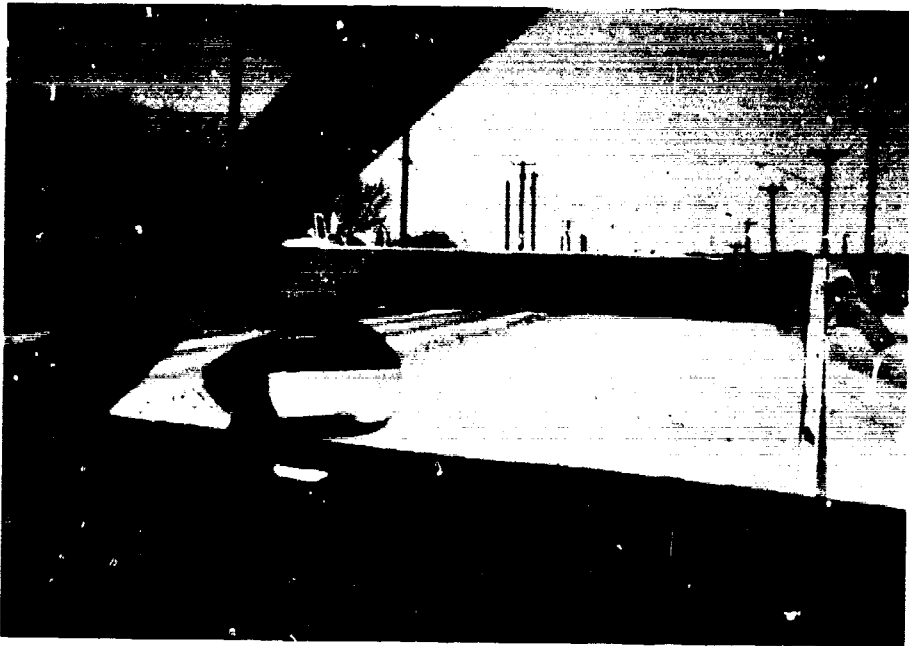


Three sandbags were placed on top of this drum for added weight and stability.



A piece of concrete was used to stabilize this drum.

--Barricades obstructed motorists' vision at intersections.



The driver's view of the semitrailer approaching from the right was obstructed.

Other conditions we observed included:

- Traffic control devices were dirty and not properly maintained.
- Traffic control devices did not provide for the safe movement of traffic from one lane to another.
- Warning signs, preceding the construction site, were missing on some projects and, on some others, were so wordy and numerous that they were confusing. Within the boundaries of the projects, signs were not used when needed, did not permit adequate response time, and were contradictory to other signs at the location. Unsafe conditions resulted from signs protruding into the roadway or being mounted so low as to be nearly invisible. Signs applicable to day work only were left uncovered at night.
- Temporary striping was not always used. Its absence on some narrow roads bordered by pavement dropoffs and curves made driving hazardous. At some locations, existing striping should have been obliterated because it could mislead motorists.
- Timber beams, used as positive barriers and for delineating traffic created unsafe conditions because most were poorly maintained, nonreflective, and disconnected, often causing them to protrude into the lanes of traffic.
- Poor flagging procedures were widespread, including failure to give advance warning of the operation, provide for flagmen when needed, properly equip the flagmen in required attire, and remove flagging warnings when the operations ceased.

While the preceding safety defects shown by these photographs may seem obvious, other problems, such as moving traffic safely from one lane to another, are not.

RECENT ACTIONS TO IMPROVE MANAGEMENT

The Highway Administration has initiated several actions to improve motorist, worker, and pedestrian safety in construction zones. Its emphasis on this problem was designed to strengthen procedures for assuring that States achieve safe construction zones. This emphasis, however, is not adequately addressing the problems noted during our review.

In May 1976, the Highway Administration said States needed to give more attention to motorist safety in construction zones. It initiated action to provide national leadership for assuring proper attention to public safety in construction zones. Specifically, it recommended that States (1) improve preliminary planning for safety, (2) assign responsibility for motorist safety to qualified personnel, (3) provide training programs as needed, and (4) inspect safety conditions at construction sites.

In implementing this, Highway Administration regional offices employed widely varying techniques. For example, one office developed a specific program to determine the status and needed improvements to State criteria for planning and managing safety efforts in construction zones. Another regional office did not issue any guidance for implementing this emphasis.

Through its inspections of State practices, the Highway Administration is aware of existing problems. In 1976, its review of 18 States' practices showed that the quality of traffic control procedures varied widely not only from State to State but also from project to project. Highway Administration followup reviews in 1977 showed several areas of improvement; however, it concluded that continuing problems were sufficiently serious to warrant further attention.

To further its emphasis, on August 25, 1977, the Highway Administration published a notice of proposed rulemaking for improving construction zone safety in the Federal Register. The rule would require each State to (1) develop a Process Management Plan for obtaining safe construction zones and (2) prepare detailed traffic control plans for each Federal-aid highway construction project. It would also require contracting agencies to designate a project level official to be responsible for and have sufficient authority to implement project safety plans.

The Highway Administration has addressed training and research by

- sponsoring a training course entitled "Traffic Control for Street and Highway Construction and Maintenance Operations" for States' use;
- contracting for development of two additional courses on construction zone safety matters;
- preparing slide presentations on barriers, barricades, and pavement markings in construction zones; and

--initiating a multistudy research effort.

As discussed in the following five sections, more Highway Administration actions are needed.

PROGRAM GUIDANCE INADEQUATE

The Highway Administration has issued standards and other program guidance to assist States to design and implement safe construction projects. The standards for construction zone safety include the Manual on Uniform Traffic Control Devices and the highway safety standards developed in response to the Highway Safety Act of 1966. The Highway Administration also considers the American Association of State Highway and Transportation Officials' publication entitled "Highway Design and Operational Practices Related to Highway Safety" as guidance. Combined with the AASHTO publication, the standards and the manual provide some management principles for construction zone safety. The manual describes what devices may be used to achieve safety.

This guidance, however, provides little information on how, why, and when these devices are to be used. Instead, the Highway Administration relies on its field offices and State highway agencies to use general program guidance and professional engineering judgment as the bases for assuring that its field offices and State highway agencies (1) develop adequate construction zone safety plans, (2) critically inspect the worksites, and (3) assess and satisfy Federal and State training needs.

Safety standards

The standards on highway design, construction, and maintenance and traffic engineering services are regulations designed to protect motorists, pedestrians, and highway workers. The first standard points out that construction zones require special attention because the accident potential is much greater than for normal highway conditions.

Together, the two standards cite several specific principles of work zone safety, including (1) need to shorten construction time, (2) limitation of construction operations to "offpeak" hours on high-volume highways, and (3) appropriate guarantees for safety within construction contracts and plans. Recognizing that poorly maintained traffic control devices lose their effectiveness and can impair highway safety, the Highway Administration recommended that the States periodically inspect all traffic control devices and correct potentially hazardous conditions in construction zones.

Manual on Uniform Traffic Control Devices

The manual prescribes the traffic control devices that may be used in construction and maintenance operations to regulate, warn, and guide traffic. But it fails to provide sufficient detail on why, when, and how the approved devices are to be used. As a result, the Highway Administration must place heavy reliance on the professional engineering judgment of State and Federal officials.

Highway Administration officials acknowledged that the manual had deficiencies, including ambiguities in describing how to achieve safe construction zones. While speaking before members of the Institute of Transportation Engineers, the Associate Administrator for Safety said, "Admittedly, the manual is vague on its requirements for construction zones and should be improved."

Other highway safety organizations and researchers have also recognized the need for better program guidance. One said that the manual should be redirected to provide optimum motorist guidance instead of an apparent overemphasis on operating efficiencies and liability avoidance. A second said that, in the absence of standards mandated by regulation, safety is often sacrificed in the interest of speed and economy because safety procedures can be time-consuming and costly.

The Highway Administration recognized major problems with its guidance for construction zones and in December 1976 initiated a comprehensive review. It is currently revising the manual and estimates completion in July 1978. The revised manual, however, will not include information on how to apply these devices because Highway Administration officials considered this information supplementary to manual provisions and were fearful that including this criteria would increase State legal liability. This rationale, however, is inconsistent with current manual provisions which already include mandatory, advisory, and permissive conditions.

INCREASED TRAINING NEEDED

There is general agreement that insufficient knowledge of and concern for construction zone safety can contribute to increased safety hazards. Project officials should not only be aware of motorists' needs, but also have sufficient engineering knowledge to provide a safe driving environment in construction zones. Several State and Federal officials we interviewed expressed a need for additional educational

efforts at the project level. Others made comments assigning much of the responsibility for construction zone safety problems to motorists' driving habits. According to the Highway Administration and some of its researchers, there is a need for construction zone safety education at the project level.

Highway Administration field offices are responsible for identifying and meeting their own construction zone safety training needs and for advising the States on solutions to their training requirements.

Most Highway Administration field offices we visited had not been actively working with the State highway departments in addressing State employee training needs. Only two field offices had recommended that States establish formal training programs. Further, State highway agencies had not satisfied their training needs. None had formal courses dealing with construction zone safety and few State personnel had attended the Highway Administration's comprehensive training course. While some Highway Administration field office personnel have attended safety slide presentations (see p. 14), these presentations are not a sufficient basis for overall management of construction zone safety. We could not identify any other training courses for construction zone safety being used by the Highway Administration field offices we reviewed.

Several State and Federal officials indicated that motorists needed to exercise more caution through construction zones. For example, one State official said the motorists are not assuming enough responsibility when driving through the construction zone and that construction zone safety practices would never meet all Federal standards because the State's number one priority was completing the project. In another instance, we called a project engineer's attention to barricades which obscured motorists' vision. His response was, "If the motorist's view is obscured, he will be more careful entering the roadway."

The need for training is demonstrated further in the following sections on construction plans and inspections.

CONSTRUCTION PLANS NEED TO BE STRENGTHENED

AASHTO has stated that when traffic is maintained through construction work zones, a well thought-out and executed traffic plan should be prepared during the design of the project. According to AASHTO, a carefully developed plan combined with constant surveillance can produce safe and expeditious traffic flow through construction operations.

The Highway Administration has required States to provide for motorist safety at highway worksites. However, thus far, it has not provided States with sufficient information on how to design and implement safe construction zones.

Other organizations concerned with highway safety have recognized the importance of planning. For example, a research organization and the Center for Auto Safety have urged that such items as lane tapers, pavement marking, and barriers should be specifically considered when developing construction zone safety plans. According to the Center, addressing such items more specifically for each project would assure timely consideration of features having a material effect on construction zone safety.

Highway Administration field offices are responsible for reviewing project designs and specifications to help insure that State highway agencies adequately consider construction zone safety for each project. However, its field offices do not have specific procedures requiring thorough and systematic evaluation of such efforts. As a result, the extent of provisions in State project designs and specifications for work-site safety vary.

In discussing the variations, State and Federal officials told us that the amount of detailed planning for construction zone safety practices was left to the judgment of the responsible project personnel. According to a Highway Administration headquarters official, Federal and State officials at the project level lack sufficient appreciation and knowledge to adequately address the problem primarily because of the low priority given to construction zone safety in the past.

Designers often relied only on a set of standard plans depicting typical situations. Although this may be a valid approach on projects where no unusual conditions exist, we found that fewer hazardous conditions were present at the sites where designs and specifications were more detailed. This was particularly true in Ohio where designers were required to prepare a detailed construction zone safety plan for all projects. In addition to the standard advance warning signs, a typical plan included provisions for such items as sign and arrow board placement, lane tapers, equipment storage, and temporary pavement markings.

In contrast, construction zone safety plans in Missouri and Texas contained little detail. In Missouri, four urban

projects characterized by high traffic densities and construction complexities had dangerous dropoffs and detours. However, project designers included only standard plans which did not address many of the unsafe conditions we observed. In Texas, an urban project had pavement dropoffs up to 3 feet in depth and needed temporary lane striping throughout the project, but neither condition was addressed in the standard plans used in the project design and specifications.

STATE SUPERVISION SHOULD BE IMPROVED

During construction, the State highway agencies are responsible for supervising the construction zone safety practices of their contractors. The need for diligent and continual inspections of projects for hazardous conditions is widely acknowledged. For example, AASHTO said that as a minimum, "drive-throughs" should be made at the beginning and end of each workday. It has also recommended that:

"Responsibilities must be assigned in order to assure proper supervision of the placement, relocation, and removal of traffic control devices during the progress of the work. Supervision must be constant and consistent from the first to the final day of the job."

Traffic safety measures are usually the responsibility of the State's project engineer or his designee.

We found that State construction zone safety inspections in some cases were inadequate and in other cases were not performed. On several projects we reviewed, project engineers said that completing projects within calendar and budget limitations was much more important than construction zone safety. A Highway Administration official pointed out that another competing priority at the State level was insuring construction quality. One State official said that, because of these competing priorities, maximum construction zone safety will probably never become a reality. Some project engineers reviewed their projects only when they drove to work in the morning and again as they returned home in the afternoon. Highway Administration officials told us that more emphasis must be placed on education so that project engineers will know why such things as "proper signing" are essential and what must be done to insure that the project is adequately designed and maintained to route traffic safely through it.

The Highway Administration's training course on construction zone safety suggests that more thorough inspections be made through the use of checklists in evaluating the effectiveness and proper maintenance of such things as traffic control devices. For the 26 projects we visited, the only instance of a checklist being used was by a State project engineer in Washington.

AASHTO said nighttime drive-throughs must be made to evaluate the adequacy of lighting and reflectorization, but officials in five of the States we reviewed said they were not required to make night inspections. We found that night inspections were not regularly performed in any of the States we visited. One project engineer said he had never made a night inspection on his project since its inception in the fall of 1976. Several of the hazardous conditions noted during our visits were found during night observations.

HIGHWAY ADMINISTRATION MONITORING NEEDS TO BE IMPROVED

Highway Administration field offices are responsible for inspecting construction sites to insure that States are properly signing and marking construction worksites. However, there is no program guidance specifying how often the engineers should inspect traffic controls or what the extent and content of these inspections should be. Instead, the scope and frequency of inspections are left to the engineering judgment of the field office director or the respective engineer.

Inspection reports are formal mechanisms for documenting construction conditions and keeping State highway agency officials apprised of Highway Administration monitoring efforts. Inspection reports we reviewed were prepared as part of overall construction project reviews to assess the status of construction, but they seldom identified construction zone hazards. Although one Federal official said Highway Administration field officials would document deficiencies only if they were unable to obtain corrective action, we noted that there were unsafe conditions which existed at the time of the inspections which were not documented and which had not been corrected. The safety problems noted at three projects are discussed in detail in appendix II.

In addition, since the engineers were not required to tour the sites at night, such inspections were usually not made. Some engineers said they usually drove through the project if they happened to remain in the vicinity overnight.

The reasons for poor inspections at the State level also exist at the Federal level. According to Federal officials, these include a lack of knowledge of how or what to inspect, a general lack of understanding about the level of effort needed to insure safe conditions, and competing time demands, such as the time required to complete environmental impact statements.

CONCLUSIONS

The Federal Highway Administration headquarters has strongly emphasized safety in construction zones. However the many hazardous conditions we found at construction worksites indicated that it has not been successful in establishing this same level of concern in its field offices and State highway agencies. Compared with their responsibilities for completing projects within scheduled time limits and insuring construction quality, they perceived construction zone safety as a lower priority.

The Highway Administration recognized many of the problems associated with achieving safe construction zones. It proposed regulations that, if implemented, should result in better traffic control and should address the potential hazards at each worksite. It has also initiated significant research efforts, developed and sponsored training programs, and is working to upgrade its manual of acceptable traffic control devices.

These efforts, however, do not entirely address the problems we identified. For example, although Federal officials were not adequately inspecting worksites for traffic safety matters, little effort had been directed toward improving these Federal inspection procedures.

The Highway Administration has not provided sufficient guidance on the proper application of traffic control devices in construction zones. Because of this lack of guidance and the failure to fully satisfy training needs, we believe State and Federal officials did not always know how and when to use the control devices.

The Highway Administration places heavy reliance on its field offices and State highway agencies to protect motorists. To accomplish this objective, the Highway Administration needs to provide specific application guidelines, develop better inspection procedures, and promote additional training on construction zone safety. Training should also be required

so project level officials become aware of safety needs in construction zones and develop the ability to plan, implement, and inspect projects for these needs.

RECOMMENDATIONS

We recommend that the Secretary of Transportation require the Administrator, Federal Highway Administration, to:

- Revise the Manual on Uniform Traffic Control Devices to include specific guidance on how and when to use traffic control devices in construction zones.
- Require training to help insure that Federal and State officials are made aware of the importance of construction zone safety and have the capability to plan, implement, and inspect these safety measures.
- Establish field office inspection procedures to identify hazardous conditions and insure that they are corrected.

AGENCY COMMENTS AND OUR EVALUATION

We discussed the above matters with Highway Administration officials and considered their views in preparing this report. They acknowledged that the driving environments in construction zones sometimes contained safety problems and that additional actions were needed to mitigate these dangers. The Highway Administration is relying on implementation of the proposed construction zone safety regulations and revisions to the Manual on Uniform Traffic Control Devices to accomplish these needed improvements. It estimates the final regulation will be issued in February 1978.

Highway Administration officials said that the Manual on Uniform Traffic Control Devices describes what devices may be used but does not contain enough information on how and when to use them. They told us that they were thinking about developing a separate handbook that would contain such guidance. However, we believe that it would be more appropriate to include this information in the manual because it officially sets forth the basic principles that govern the design and usage of such devices.

Highway Administration officials agreed that their field offices were not frequently inspecting projects. Although they objected to developing checklists as management tools, they believed their field offices should develop procedures for reviewing the effectiveness of provisions for construction zone safety.

Highway officials acknowledged the need to train their field officials and State highway personnel on how to plan and implement safe construction zones. They said that the proposed regulations would require States to provide information on training needs and that Highway Administration field offices would then determine the sufficiency of the proposed training to meet those needs. We believe that, in adopting this regulation, the Highway Administration should insure that training needs are fulfilled at the project level, including an explanation of the importance of and methods for achieving construction zone safety.

The Highway Administration has expressed concern about safety problems in construction zones for over 11 years. Although it has taken some actions that should help improve safety in construction areas, our recommended additional actions are necessary to achieve construction zone safety. Since the field offices do not make detailed reviews of each traffic control plan, it is especially important that additional guidance and training be provided to State officials. Further, to maximize the effectiveness of its field offices, the Highway Administration should establish inspection procedures to identify and correct safety hazards in construction zones.

SITES VISITED
DURING OUR REVIEW

<u>States</u>	<u>Project number</u>	<u>Type</u>	<u>Length</u> (miles)	<u>Average vehicle daily traffic</u>
Louisiana	I-10-5-(176)233	Urban	1.0	95,720
Louisiana	M-9391(002)	Urban	1.4	26,200
Mississippi	ROS-008-1(28)	Rural	0.3	12,000
Mississippi	RF-014-2(12)	Rural	7.6	3,500
Missouri	TQF-66-6(4)	Urban	3.0	39,930
Missouri	M-5575(601)	Urban	1.5	13,000
Missouri	M-5575(602)	Urban	0.5	13,000
Missouri	M-5575(603)	Urban	0.4	83,700
	I-TQFI-81-2(127)077/ I-TQFI-690-3(36)214		8.6	78,000
New York	I-UI-690-3(35)208	Urban	7.0	23,100
New York	M-5055(1)	Urban	1.5	57,900
New York	I-278-1(160)	Urban	10.7	63,800
Ohio	I-IR-70-7(62)200	Rural	3.3	13,550
	I-70(51)156/ RFI-UI-70-7(61)156	Rural	3.5	40,000
Ohio	I-IR-71-3(66)80	Rural	10.3	Not available
Ohio	I-IR-71-3(59)91	Rural	3.4	Not available
Texas	MQ000(1)	Urban	2.0	14,500
Texas	MQ021(1)	Urban	1.0	28,200
Texas	I-30-5(38)053	Urban	0.3	Not available
Texas	I-30-5(41)052	Urban	5.0	81,940
Texas	MS002(1)	Urban	1.8	26,180
Texas	TQMS265(1)	Urban	2.3	20,210
Washington	I-90-1(112)15	Rural	0.9	19,000
Washington	I-90-1(107)16	Rural	1.3	14,900
Washington	I-5-1(112)35	Rural	1.5	26,000
Washington	I-5-1(114)39	Rural	1.3	24,300

OUR OBSERVATIONS FOR
THREE PROJECTS VISITED

PROJECT 1

Ocean Parkway
Brooklyn, New York
Date started: 8/16/76
Length: 1.5 miles
Number of Federal Highway Administration (FHWA) Inspections: 1

FHWA inspection findings

Maintenance and protection of traffic was satisfactory. The inspection was performed in November 1976.

GAO Observations in May 1977

This project consisted of resurfacing a badly deteriorated six-lane street through a heavily populated residential area. Traffic was maintained on two outside lanes in each direction, while the two middle lanes were under construction. The project was characterized by heavy pedestrian traffic, narrow traffic lanes, and numerous intersections.

The engineer-in-charge had previously withheld payments to the contractor and was considering assessing further penalties for failure to comply with traffic safety measures. The engineer had cited some deficiencies noted during our inspections just 2 days prior to our visit. He had suggested the contractor appoint someone fulltime to traffic control.

During our visit we noticed:

--Timber curbs were not connected together and protruded into traffic lanes. The ends at intersections were not tapered as required by project plans and, therefore, were blunt 12-inch obstacles to oncoming traffic. (See photograph, top p. 26.)



- The lack of crosswalks at a number of intersections (as required by the project plans) forced pedestrians to use traffic lanes when crossing the street.
- Unnecessary striping was not obliterated at intersections. This tended to contradict the direction in which timber curbs channeled traffic. Therefore, motorists were receiving conflicting guidance.
- Flagmen were not always used when needed. (See following photograph, top p. 27.) In instances where workers were directing traffic, they did not wear reflective attire or comply with flagging procedures set forth in the manual.
- Amber reflectors on top of metal bars were dirty and not reflective at night. Many of the metal bars were bent and often projected into the traffic lane.
- Materials were stored in a fenced enclosure which abutted the street curb and were not reflectorized for night visibility. (See photograph, p. 8.)
- Traffic control devices were in poor condition.



--Confusing and superfluous signs were common at intersections.

--Some signs were too wordy for quick comprehension.
(See following photograph.)



PROJECT 2

Lindberg Boulevard
St. Louis, Missouri
Date started: Fall 1976
Length: 3 miles
Number of FHWA Inspections: 0

GAO Observations in May 1977

This project consisted of widening a street and a bridge and installing traffic signals. Traffic was sometimes congested and speeds varied from about 25 mph to 40 mph, depending on the time of day.

The site engineer described the project as one of the toughest he had supervised, with the worst set of construction zone safety plans he had ever seen. Throughout the project, there were deep excavations and shoulder dropoffs which presented formidable hazards not addressed in the plans. He said the plans included no details for detours, and, for the most part, traffic control had been left to his judgment. For instance, the plans originally specified only four barricades for the entire project when, according to the engineer, that many could have been used at just one intersection.

The site engineer's project inspections consisted of a cursory review as he drove to and from work. He had not inspected the project at night. We observed the following conditions.

- Culvert excavation, ranging in depth from 3 to 7 feet, was inadequately delineated throughout the project. At one location, for example, a crane was used to mark the hazard by being parked on the road shoulder in front of the excavation. The equipment was difficult to see at night and presented a hazard as great as the one it was marking. (See photograph, p. 7.)
- Traffic control devices were extremely dirty and in poor condition.
- Pavement dropoffs were marked with cones which were adequate during the day but were not readily visible at night.

- Excavated portions of the street were not completely shut off to traffic. Poor lighting and improper markings made these locations hazardous.
- "Open Trench" signs were difficult to see--too low and in the excavation instead of preceding it. (See following photograph.)



- At one intersection permanent and temporary striping gave motorists conflicting messages. The permanent striping led directly into grading work adjacent to the street. This was particularly hazardous at night since drivers had to make a sharp turn while receiving simultaneous but conflicting messages on which way to go.

PROJECT 3

Wurzbach Road
San Antonio, Texas
Date started: June 10, 1976
Length: 2 miles
Number of FHWA inspections: 3

FHWA inspection findings

None.

GAO observations in March 1977

This project involved widening a two-lane road to four lanes. Two lanes remained open at all times. Driveways to many small businesses along the road complicated the project. Although the speed limit had been lowered temporarily to 20 mph, the traffic normally flowed between 35 and 40 mph. Grading operations were in progress adjacent to the two lanes open to traffic, and dropoffs up to 10 inches deep were common.

The site engineer advised us that he inspected the project at night only if he happened to be in the area, and even then the inspection was only a cursory drive-through.

We observed the following conditions:

- There was no temporary striping on the portion of the road open to traffic. This created a hazard since the two lanes were narrow and the motorists were often confronted with a severe dropoff. (See photographs on the next two pages.)

--Warning devices marking hazardous drops were located as much as 300 feet apart, as shown in the photograph below.



--At one end of the project, a taper to move traffic over to another lane was only 30 feet long. We observed traffic making erratic turns because of this unnecessarily short taper. A motorist ran into the barricades in the taper while we were inspecting the project.



--Barricades used to mark access drives to a shopping center obstructed the view of drivers entering the busy roadway from the shopping center.

--Temporary speed limit signs adjacent to normal speed limit signs gave conflicting instructions to motorists.

--An arrow sign attached to a barricade was used to mark an obstruction on the side of the road. The arrow suggested a turn where there was no need to turn.

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