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**NATIONAL  
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SAFETY  
BOARD**

WASHINGTON, D.C. 20594

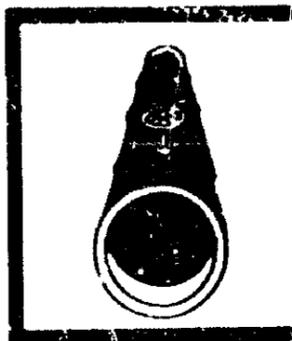
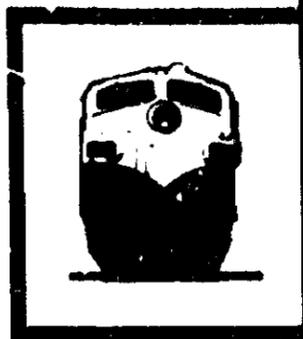
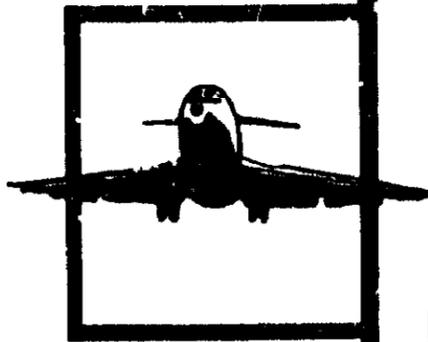
**HIGHWAY ACCIDENT REPORT**

**CATES TRUCKING, INC.,  
TRACTOR-SEMITRAILER/MULTIPLE-VEHICLE  
COLLISION AND OVERRIDE, I-285  
ATLANTA, GEORGIA  
JUNE 20, 1977**

**REPORT NUMBER: NTSB-NAR-78-5**

**UNITED STATES GOVERNMENT**

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| 16. Abstract<br>By 3:05 p.m., e.d.t., on June 20, 1977, traffic had backed up and stopped in the right lane of I-285, eastbound, just south of downtown Atlanta, Georgia, and west of a construction zone which was located on connecting I-75 southbound. An eastbound Cates Trucking, Inc., tractor-semitrailer combination vehicle approached the standing traffic at between 35 and 45 mph and collided with and overrode the last automobile in the queue. The automobile was pushed into the vehicle ahead, and two other vehicles to its front were subsequently involved. No fire ensued. Four persons in the automobile were killed, and one was hospitalized; a second driver received minor injuries.<br><br>The National Transportation Safety Board determines that the probable cause of this accident was the failure of the truckdriver to maintain the proper level of attention to the driving task and perceive the standing vehicles on the roadway and stop his vehicle short. (The Safety Board believes that the driver's inattention to the traffic in front of him may have resulted from fatigue. Contributing to the accident was the failure of the Georgia Department of Transportation to implement existing standards and guidelines for controlling traffic through construction zones, which permitted a 3 1/2-mile backup of slow moving and stopping traffic. |   |  |                                    |
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NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

Adopted: September 14, 1978

CATES TRUCKING, INC., TRACTOR-SEMITRAILER/  
MULTIPLE-VEHICLE COLLISION AND OVERRIDE  
I-285 ATLANTA, GEORGIA  
JUNE 20, 1977

SYNOPSIS

By 3:05 p.m., e.d.t., on June 20, 1977, traffic had backed up and stopped in the right lane of I-285, eastbound, just south of downtown Atlanta, Georgia, and west of a construction zone located on connecting I-75, southbound. An eastbound Cates Trucking, Inc., tractor-semitrailer combination vehicle approached the standing traffic between 35 and 45 mph, and collided with and overrode the last automobile in the queue. The automobile was pushed into the vehicle ahead, and two other vehicles to its front were subsequently involved. No fire ensued. Four persons in the automobile were killed, and one was hospitalized; a second driver was injured slightly.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the truckdriver to maintain the proper level of attention to the driving task and perceive the standing vehicles on the roadway and stop his vehicle short. The Safety Board believes that the driver's inattention to the traffic in front of him may have resulted from fatigue. Contributing to the accident was the failure of the Georgia Department of Transportation to implement existing standards and guidelines for controlling traffic through construction zones, which permitted a 3 1/2-mile backup of slow moving and stopping traffic.

INVESTIGATION

The Accident

On the afternoon of June 20, 1977, closure of a through lane in a construction zone on southbound I-75 south of the city of Atlanta, Georgia, resulted in traffic delays on that roadway. As traffic volumes increased, by about 3:00 p.m., <sup>1/</sup> the congestion caused traffic to back up throughout the I-75 southbound construction zone, as well as on the section of I-75 southbound before the construction zone. The area included the I-75 and I-285 interchange which was located just southeast

<sup>1/</sup> All times herein are eastern daylight time, unless otherwise indicated.

of the Atlanta International (Hartefield) Airport. That congestion resulted in the formation of a queue back through the acceleration lane from the I-285 eastbound to the I-75 southbound connecting ramp. The queue then extended up the ramp, past the acceleration lane of I-285 eastbound, and onto the I-285 eastbound right through lane for about 1/2 mile west of the interchange. (See figure 1.)

As traffic slowed to a stop, the last vehicles to join the standing queue in the right through lane on eastbound I-285 were, first, a Plymouth Fury towing a camper-trailer (hereafter known as Vehicle 1), then, a Volkswagen sedan (Vehicle 2), third, a Dodge Polara towing a camper-trailer (Vehicle 3), and finally, a Chevrolet Vega Kamback stationwagon (Vehicle 4).

A Cates Trucking, Inc., tractor-semitrailer combination vehicle (truck) was following behind Vehicle 4. The truckdriver estimated that he was traveling between 30 and 40 mph to keep pace with the slowing traffic some 2 1/2 to 3 car lengths behind Vehicle 4, when he glanced up at a low flying aircraft. The driver stated that when he looked back to the roadway ahead he realized that traffic was not moving. Although he stated that he attempted to stop the truck, there was no evidence of precrash braking by the truck.

The truck struck the rear of Vehicle 4 and completely overrode it; its front wheels came to rest on the hood of that vehicle. The momentum of the truck forced Vehicle 4 into the camper-trailer being towed by Vehicle 3. Vehicle 3 moved forward and struck Vehicle 2. Since the wheels of Vehicle 2 had been turned to the left in anticipation of a lane change, it sideswiped the left rear of the trailer being towed by Vehicle 1, crossed the passing lane, and came to rest in the median. Vehicle 3 and its trailer came to rest across the two eastbound lanes of I-285. Vehicle 4, which was lodged under the truck, came to rest in the Clark Howell Highway exit lane. (See figure 2.)

The weather was clear and the roadway dry.

#### Injuries to Persons

| <u>Injuries</u> | <u>Drivers</u> | <u>Passengers</u> | <u>Other</u> |
|-----------------|----------------|-------------------|--------------|
| Fatal           | 1              | 3                 | 0            |
| Nonfatal        | 1              | 1                 | 0            |
| Minor/None      | 3              | 6                 |              |

All fatally injured persons were occupants of Vehicle 4. The sole survivor, a 9-year-old female, was seated in the center of the rear seat. She received moderate injuries and was hospitalized.

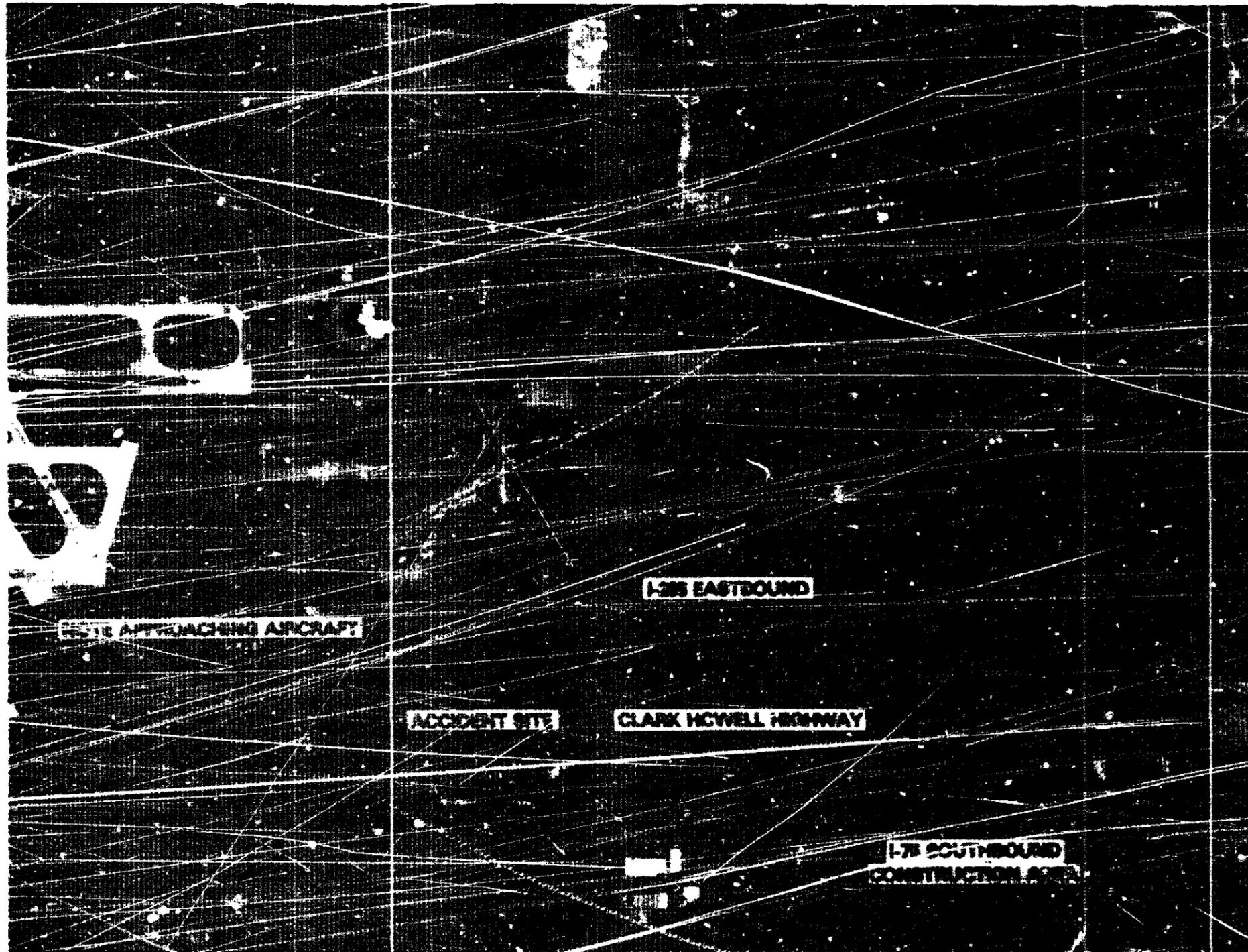


Figure 1. Aerial view of accident site.

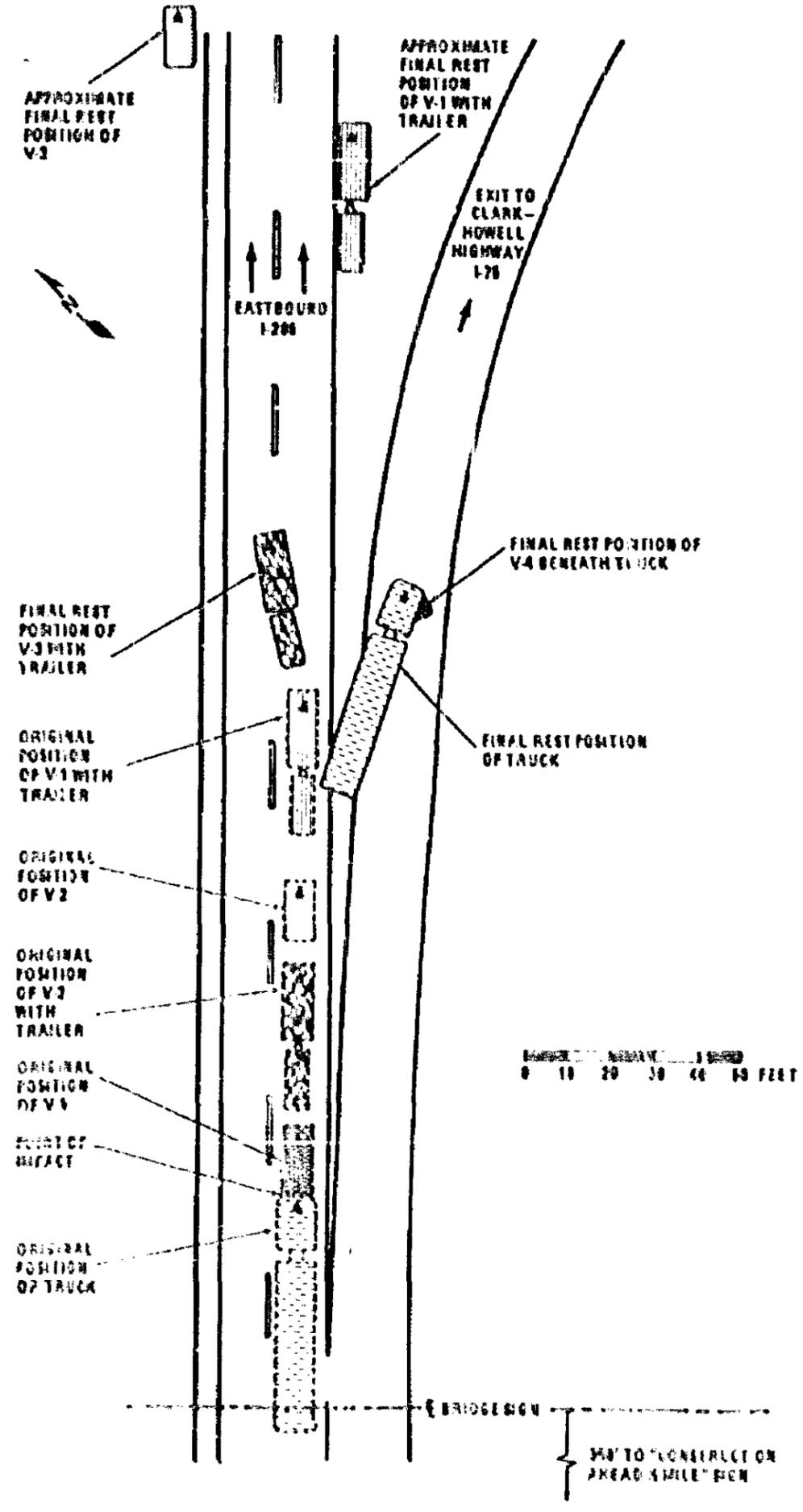


Figure 2. Plan view of accident site.

The truckdriver, the four occupants of Vehicle 1, and the four occupants of Vehicle 3 were not injured; the driver of Vehicle 2 was injured slightly. None of these were hospitalized.

#### Vehicle Information

The truck was owned by Cates Trucking, Inc., of Swayzee, Indiana. The vehicle was being operated by Cates under a trip-lease agreement with J. H. Ware Trucking, Inc., of Fulton, Missouri, a for-hire carrier authorized by the Interstate Commerce Commission.

The tractor was a 3-axle, 1966 Mack, conventional cab Model R-609ST. It was equipped with a 675-cubic-inch, 6-cylinder, 237-HP diesel engine, with air-mechanical brakes, and with a Maxidyne 5-speed transmission.

The semitrailer was a 2-axle, 1969 Fruehauf, 40-foot, dry freight-type van. The van was carrying a combination cargo of paper magazines and tomato products weighing 44,001 pounds. The gross vehicle weight (GVW) of the truck was approximately 70,000 pounds. All tires on the unit were 10.00 x 20 and had tread depths of more than 1/8 inch.

Postcrash inspections revealed that the truck was well maintained with no apparent mechanical defects. The brakes were found to be in good condition and properly adjusted. Postcrash inspection of the other four vehicles revealed no significant mechanical defects.

#### Damage to Vehicles

The truck sustained some damage to its undercarriage. Some deformation of the front bumper, grill, and fenders on both sides was also visible. (See figure 3.) The semitrailer was not damaged, and the combination unit was driven soon after being removed from the accident site.

Vehicle 4 was destroyed. (See figure 4.) Vehicles 2 and 3 were damaged moderately. Vehicle 1 was driven from the accident site with only minor damage. (See Appendix for a detailed description of vehicle damage.)

#### Driver Information

The 27-year-old truckdriver had been employed by Cates Trucking, Inc., since January 1977. He held a valid Indiana chauffeur's license as required for the operation of a vehicle of the truck's size and weight configuration. Indiana authorities reported no traffic violation convictions on his driver's record. The driver stated that before this accident he had been involved in one accident in 1972 and since had no additional incidents.



Figure 3. Vehicle 4 beneath truck-trailer.

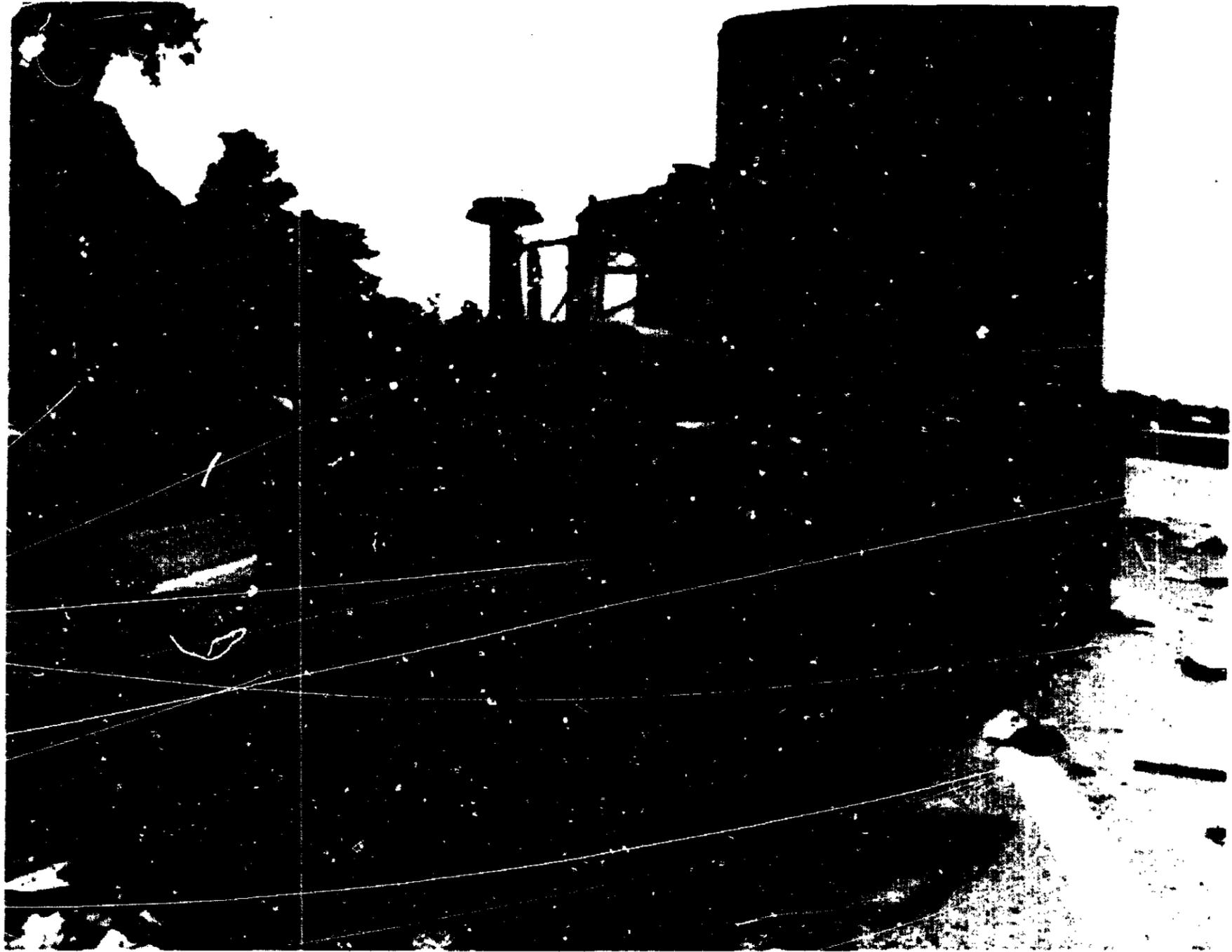


Figure 4. Front of tractor-semitrailer unit.

Investigation by BMCS investigators revealed that the truckdriver had less than 1 year of regular driving experience with this type of vehicle in interstate service.

Between July 1976 and January 1977, the driver was employed by Building Units, Inc., of Gas City, Indiana, as a plant worker and truckdriver. In this position, he drove a tractor-semitrailer to make deliveries in Indiana, Ohio, and Illinois. From January 1977 until the time of the accident, the driver was employed by Cates Trucking, Inc., driving units similar to the truck involved in this accident through the Eastern and Southern States.

The truckdriver's training and experience consisted of completion of a commercial driving school course in December 1974 and employment as a commercial driver since July 1976. The driver had in his possession a medical examiners certificate as required by the Federal Motor Carrier Safety Regulations (FMCSR) Part 391.41, which states that he was qualified to drive in interstate commerce. The medical certificate bore the signature "Gene C. Locker, M.D." Further investigation found no such doctor at the address given. A Dr. Gene C. Laker was located in Fort Wayne, Indiana; however, Dr. Laker stated that he had not examined the truckdriver and that the signature on the medical certificate was not his. Following the accident, the truckdriver was given a physical examination by a Marion, Indiana, physician, who found him physically qualified to drive in interstate commerce and who signed a certificate to that effect. The Safety Board attempted to determine the source of the false certificate, but the truckdriver refused to discuss the matter with investigators.

Additionally, the driver's employment file at the carrier was incomplete. Missing from this file were the driver's written examination certificate, past driving violations certification, record of driver's license check or background investigation of the driver's past driving experience or training, and his road driver's certificate. These documents are required by FMCSR Part 391.51.

On June 19, 1977, the truckdriver drove the tractor from the Cates terminal in Swayzee, Indiana, to Kokomo, Indiana -- about 16 miles -- where he picked up the loaded semitrailer. The cargo was destined for Tampa, Florida, with an intermediate drop in Jacksonville.

After reviewing the times and distances shown in the driver's log, the Safety Board reconstructed what it believed to be a more accurate record of the driver's trip. The reconstructed record is based on service receipts, witness statements, and trip records.

The following is a chronological listing of the driver's times and activities taken from the driver's logs compared to the reconstructed times and activities:

| <u>Driver's Logs</u> |                         |                      | <u>Computed Time Data</u> |                                     |
|----------------------|-------------------------|----------------------|---------------------------|-------------------------------------|
| <u>Date</u>          | <u>Time</u>             | <u>Activity</u>      | <u>Time</u>               | <u>Activity</u>                     |
| June 19              | 2:00 p.m. <sup>2/</sup> | End 8 hours off duty | 12:00 Noon                | End 8 hours off duty                |
|                      | 2:00-6:00 p.m.          | On duty driving      | 12:00-3:00 p.m.           | On duty driving                     |
|                      | 6:00-7:00 p.m.          | Off duty             | 3:00-4:30 p.m.            | On duty (not driving)               |
|                      | 7:00-9:30 p.m.          | On duty driving      | 4:30-7:30 p.m.            | On duty driving                     |
|                      | 9:30-12:00 Mid          | Off Duty             | 7:30-10:30 p.m.           | On duty (not driving)               |
|                      |                         |                      | 10:30-12:00 Mid           | On duty driving                     |
| June 20              | 12:00-12:30 a.m.        | Off duty             | 12:00-12:30 a.m.          | On duty driving                     |
|                      | 12:30-2:30 a.m.         | On duty driving      | 12:30-6:16 a.m.           | On duty (not driving) <sup>3/</sup> |
|                      | 2:30-9:30 a.m.          | Off duty             | 6:15-7:45 a.m.            | On duty driving                     |
|                      | No further entries      |                      | 7:45-12:00 Noon           | On duty (not driving)               |
|                      |                         |                      | 12:00-2:00 p.m.           | On duty driving                     |

At the time of the accident, the truckdriver had driven about 608 miles following his last period of 7 consecutive hours off duty. During this 26-hour period, he had been continuously on duty and had been driving for 11 1/2 hours. The truckdriver exceeded both elements of the FMCSR daily driving hour limitations. FMCSR 395.3(a) states, "no motor carrier shall permit or require any driver used by it to drive nor shall any such driver drive for any period after having been on duty 15 hours following 8 consecutive hours off duty...." <sup>4/</sup> He had driven more than 10 hours following 8 consecutive hours off duty and had driven 3 1/2 hours after having been on duty for 15 hours.

<sup>2/</sup> A second log carried by the driver showed a 3:00 p.m. starting time on 6/19. The driver stated that 2:00 p.m. was the correct time as shown in the one log as related above.

<sup>3/</sup> Included about 5 hours sleep across seat of tractor. This is not recognized by FMCSR as "sleeper berth" time. Other time spent eating or servicing truck.

<sup>4/</sup> 49 CFR 211.1, October 1, 1976, with ancillaries.

Vehicle 4 was driven by a 17-year-old female. She and the four other occupants, ages 9 to 18, had been traveling about 6 hours on the day of the accident. The drivers of Vehicles 1 and 3 were, respectively, 42- and 48-year-old males traveling with their families; they had been traveling since 9:00 a.m. on the day of the accident. The driver of Vehicle 2 was a local 25-year-old male. All the drivers of the four vehicles were properly licensed.

#### Roadway Information

Interstate 285 is a 62-mile, limited-access highway that circles Atlanta, Georgia. Through the accident area, it ran east and west.

Of the more than 40 interchanges on I-285, those intersecting Interstates 75 and 85 experience some of the heaviest volumes of traffic in the system. I-285 provides a nearly equal-distance alternative to I-75 which travels through the center of the metropolitan area. Four of the five vehicles involved in this accident were using I-285 as an alternative to I-75.

The roadway at the accident site had two 12-foot bituminous-paved through lanes in each direction. The eastbound and westbound traffic was separated by a 40-foot median, which consisted of 30 feet of grass and a 5-foot paved shoulder in each direction. In addition to the two eastbound through lanes at the point of impact, there was a parallel deceleration lane for the exit. (See figure 2.) The road surface was in good repair.

At the Safety Board's request, skid tests were performed by the Georgia Department of Transportation (DOT). A skid trailer, which conformed to the requirements of the American Society for Testing and Material Methods (ASTM) E-274, was used. The wet pavement tests conducted at 40 mph yielded an average skid number of 44.3 for the right eastbound lane. This indicates an acceptable coefficient of friction when compared to the recommended skid number of 37. <sup>5/</sup>

The point of impact was located 2,500 feet west of the nose of the raised concrete gore at the deceleration lane which traveled from I-285 east to I-75 south. About 3 miles beyond this gore, the construction zone lane closure began on I-75 southbound.

The accident site was on a -1.198-percent grade and about 50 feet east of the end of a 300-foot crest vertical curve. The curve connected the grade with a -0.314-percent grade. The site was about one-fourth of the way into a one-third-mile-long, 1° horizontal curve to the right.

<sup>5/</sup> Highway Safety Program Standard Manual No. 12, Section III, Federal Highway Administration.

In addition to the standard regulatory and guide signs on I-285 in the area of the accident site, a number of warning signs referring to the I-75 southbound construction zone were in place. The signing used was in accordance with the recommended practices for types and design prescribed in Part VI of the Manual on Uniform Traffic Control Devices (MUTCD). <sup>6/</sup> At the time of the accident, a 48-inch x 48-inch advance road construction sign with the legend "Road Construction 1/2 Mile" was located about 420 feet west of the point of impact. It was mounted 6 feet above the ground and just south of the guardrail which bordered the 9-foot-wide shoulder. Other construction zone warning signs were located east of the accident site.

The posted speed limit on I-285 was 55 mph. There were no advisory speed plates in place on any of the signs mentioned above, and there were no posted speed reductions for any portion of the through lanes on approach to or at the accident site.

The nondirectional average daily traffic count between Clark Howell Highway and I-75 on I-285 was 55,695 for 1977. Accident records for the period from 1971 through 1977 showed a total of 219 accidents in the eastbound direction within 1 mile of the accident site. A study of accidents during the construction period compared to a similar period and during comparable time frames before the construction began showed a similar percentage of eastbound rear-end accidents (67 percent before vs. 65 percent during).

An investigation of a similar site on I-285 showed no statistically significant difference in the percentage of rear-end accidents at this site from expected values.

The roadway alignment in this area is such that aircraft in their final approaches to runways 27 left and 33 at Atlanta International (Hartsfield) Airport overfly the roadway at low altitudes. (See figure 1.)

The closing of all but one lane of traffic on I-75 -- a major interstate highway -- with the resulting 3 1/2-mile traffic backup was not in compliance with Federal Highway Administration (FHWA) recommended practices, <sup>7/</sup> the MUTCD policies regarding construction zones, <sup>8/</sup> and Highway Safety Program Standard No. 12, "Highway Design, Construction, and Maintenance."

<sup>6/</sup> Manual on Uniform Traffic Control Devices, Part VI "Traffic Controls for Streets and Highways Construction and Maintenance Operations," pp. 276-320, U.S. Department of Transportation Federal Highway Administration (1971).

<sup>7/</sup> FHWA TS-77-204 "Office Function Volume 1 - Traffic Controls in Construction and Maintenance Work Zones," issued May 1977, p. 26.

<sup>8/</sup> FHWA Manual on Uniform Traffic Control Devices.

The FHWA recommended practice of "Acceptable Levels of Service" states, "There are occasions when the amount of traffic past a construction site is not predictable. When this occurs, a rule-of-thumb to determine how much street can be closed is that no vehicle in either lane should suffer more than a 90-second delay."

Another section of the Manual titled "Freeway Maintenance" states, "Special consideration must be given to closing lanes for freeway maintenance. In most urban areas freeway lanes cannot be closed during peak hours, and closing lanes even during nonpeak hours often creates extensive congestion. Under these conditions night work is often done to meet maintenance needs. Before daytime freeway lane closures, traffic pattern studies should be made of closing a lane or lanes of a freeway to determine the consequences of such closures. Whenever possible, freeway traffic should be allowed to proceed past the work site at normal speeds or to adjust voluntarily to lower speeds as required."

Section 6E-1 of the Manual states that the primary function of traffic control procedures is to move traffic safely and expeditiously through or around work areas. Section 6F-1 states, "A major consideration in the establishment of traffic controls is the vehicular speed differentials which exist and the limited time for drivers to safely react to unusual conditions." Section 6F-6 states that the objective of traffic control in maintenance and construction areas is to allow a free flow of traffic by keeping the maximum number of lanes open to traffic at all times.

And finally, Standard No. 12 states, "Where feasible, construction, and maintenance operations should be limited to off-peak hours on high volume roadways. Peak-hour restrictions on road work activities can materially reduce traffic congestion and its associated hazards. Savings in construction costs should not be the only criteria for determining project sequencing. These costs must be weighed against the increased delay and hazard created by interrupting the safe flow of traffic."

#### Medical and Pathological Information

Each of the four occupants in the front and rear outboard positions of Vehicle 4 sustained fatal massive head traumas. The passenger in the center of the rear seat survived the accident and was hospitalized with moderate injuries.

Postcrash tests of the truckdriver by the police revealed no alcohol or drug involvement. There was no evidence to suggest that any of the other persons involved in the accident were under the influence of alcohol or drugs.

#### Survival Aspects

Emergency personnel responded promptly. The fire department was the first on the scene about 10 to 15 minutes after the crash. Personnel

at the scene notified the dispatcher that a crane would be needed to remove the truck since there was a survivor in Vehicle 4, which was crushed beneath the tractor.

A crawler-loader in transport on I-285 was used in an attempt to lift the truck-tractor. Rescuers were able to relieve some of the weight of the truck-tractor from Vehicle 4 using this equipment. A crane arrived 45 minutes after the crash and removed the truck-tractor from atop Vehicle 4. The sole survivor was removed and transported to a local hospital for treatment.

### ANALYSIS

#### The Accident

Vehicle damage patterns, skid marks, and pavement gouges indicated that the truck's front bumper squarely impacted the rear hatch of Vehicle 4, just above its bumper. The stopped Vehicle 4 was forced forward and downward as the truck mounted it, leaving a 4- to 6-foot group of parallel gouges where its frame components contacted the pavement. The lift of the truck apparently resulted from the ramp-type structural configuration and pattern of deformation of the rear of Vehicle 4.

Vehicle 4 continued forward, struck the rear of the camper-trailer being towed by Vehicle 3, and rotated clockwise about 40°. The tractor completed its climb over Vehicle 4, crushing it downward. As a result, the frame of Vehicle 4 began to gouge the pavement again.

The tractor, still attached to the semitrailer and on top of the automobile, continued forward for about an additional 100 feet. Both vehicles came to rest across the right through lane and exit deceleration lane of eastbound I-285.

#### Pre-crash Truck Operation

Considering the momentum transferred from the truck to the stopped vehicles, its pre-crash speed was calculated to have been between 35 and 45 mph. Statements by witnesses and the truckdriver and an evaluation of the truck's performance characteristics indicate this to be a reasonable estimate. This range of speed was utilized in the analysis of the pre-crash operation of the truck.

Statements by drivers of other involved vehicles indicate that Vehicles 1, 2, 3, and 4 were stopped in the through lane before the collision. Crash dynamics indicate that it is likely that the 2 1/2 to 3 car lengths referred to by the truckdriver was that gap between Vehicle 4 and the truck that existed when the truckdriver first became aware that traffic ahead had stopped.

If the truck was an estimated 2 1/2 to 3 car lengths (50 to 60 feet) behind the stopped Vehicle No. 4 and traveling at an estimated 35 to 45 mph (51 to 66 ft/sec), it was within 1 second's travel time of the vehicle stopped ahead. In order to perceive and react to the stopped vehicle, the truckdriver would have required 2.5 seconds <sup>9/</sup> or 1.5 seconds more than was available to him. In this case, the evasive action called for either a brake application to stop or steering into the open left lane. The truckdriver, however, did not have time either to get his foot on the brake pedal or to turn the steering wheel. There was no preimpact deceleration; the absence of preimpact skid marks further substantiates this conclusion. Calculations show that less than 300 feet would have been sufficient for the truckdriver to react to the hazardous situation ahead of him and safely stop the truck. <sup>10/</sup> This would have required an estimated 7.7 seconds at 35 mph. A controlled, evasive lane change to avoid the collision could have required nearly 350 feet <sup>11/</sup> and 6.8 seconds. This includes time to react to the situation as well as to actually complete the maneuver.

There were no obstructions for more than 1/4 mile to block the truckdriver's view; however, there was the distraction of the low-flying aircraft. An examination of the reconstructed log indicates that the truckdriver had been on duty for 25 hours at the time of the accident and had driven about 11 1/2 hours since his last 8 consecutive hours off duty. Apparently, the only rest he had during the 608-mile trip was the 5 hours he spent sleeping across the seat of his tractor between 12:30 a.m. and 5:30 a.m. on the morning of the accident.

Therefore, based on the absence of preimpact skid marks at the site, on the absence of obstructions to the truckdriver's view of the queue, on the presence of the low flying aircraft, and on the reconstructed log, the Safety Board concludes that the truckdriver was operating at a marginal level of attention due to fatigue and distraction.

#### Construction Zone Traffic Operations

On the day of the accident, paving operations on I-75, southbound, required that one through traffic lane be redirected onto a temporary shoulder lane in order to maintain two lanes of travel. About 1:30 p.m., the use of the shoulder was stopped because of space restrictions as paving operations approached an overpass. From this time on, only one lane of southbound I-75 traffic was maintained. This flow restriction probably created the standing queue on the I-285 eastbound right lane.

<sup>9/</sup> "A Policy on Geometric Design of Rural Highways," American Association of State Highway Officials, Washington, D.C., (1965), pp. 135 and 139.

<sup>10/</sup> Ibid.

<sup>11/</sup> Ibid.

Probably, if the construction zone work had been planned to comply with the guidelines set forth in Highway Safety Program Standard No. 12, the FHWA's Traffic Control in Construction Zones, and the MUTCD, the traffic backup on the two interstate routes could have been avoided. The Georgia DOT should review its maintenance policies and practices and assure that they comply with the standards and guidelines which have been developed and propagated so that such situations can be avoided. The FHWA in its oversight role of the States should monitor State construction projects and encourage compliance with the Standard and established guidelines. Efforts should be made to assure that highway maintenance personnel and contractors are aware of and make provisions in their planning and work programs for (1) identification of problem areas in heavily traveled, high-speed highway zones, and (2) rerouting traffic or working around the peak volume hours.

In recognition of the special problems associated with traffic safety in construction zones, the Georgia DOT has created a traffic engineering position specifically designated to oversee traffic operations and safety in construction zones. In May 1978, a full-time traffic control engineer was appointed within the Department to design interstate roadway work sites in Atlanta and monitor them.

Construction zones similar to those on I-75 are rapidly becoming commonplace on interstate highways for a number of reasons. First, the relatively common completion date of much of the system has resulted in a coincidental repair and replacement schedule for many sections of the network. Secondly, for the interstate system as well as many of the existing urban and rural freeway systems, growth in traffic volumes has required that facility capacities be increased in order to provide a desirable level of service to motorists. And thirdly, technical advances in operational and safety systems have led to increased remedial construction work on limited access and other major roadways currently experiencing high traffic volumes.

Warning sign layouts in construction zones on high speed, heavily traveled highways need to be designed for that specific use. Existing signing and marking standards consider the information needs of drivers operating on rural, low-volume roadways. <sup>12/</sup> These rural operations usually afford more stopping distance and lateral clearances to accommodate for driver reactions. Additionally, the rural area usually contains fewer distractions and control devices to compete for a driver's attention. In spite of these differences, current traffic management strategies at urban freeway construction zones are mere modifications of rural, low-volume road standards. <sup>13/</sup>

<sup>12/</sup> "Evaluation of a Prototype Safety Warning System on the Gulf Freeway," C. L. Dudek, et al, Texas Transportation Institute, Texas A&M University, Research Report 163-13 (July 1974).

<sup>13/</sup> "Traffic Management During Urban Freeway Maintenance Operations," Research Proposal, Texas Transportation Institute, Texas A&M University, Research Study No. 2-18-78-228 (1977).

In recognition of these differences the Texas Transportation Institute (TTI) of Texas A&M University studied a system of real-time warning signals which were operational on the Gulf Freeway in Houston in an attempt to deal with driver expectations. By using paired loop detectors tied to a digital computer, the system was capable of sensing stopped traffic and warning drivers of adverse conditions ahead. In a report dated July 1974, <sup>14/</sup> the TTI concluded that the system was a cost-effective means for reducing both primary and secondary accidents which occur as a result of standing queues. Additional research by TTI is being conducted to study the adequacy of current operational techniques for signing at highway construction zones. <sup>15/</sup> Possible uses of real-time warning systems are to be included in this study.

This latest research by TTI and other efforts are part of a program initiated by the FHWA's Office of Research. The program is aimed at improving construction and maintenance zone operations, including the system of signing and marking construction zones. This and similar accidents emphasize the need for improved signing and markings practices.

#### Vehicle Override

The results of the impact of the truck with the rear of Vehicle 4 demonstrates the severity of accidents which can be expected from less-than-adequate rear-end protection on vehicles.

The lower edge of the front truck-tractor bumper was 20 inches from the ground and the top of the rear automobile bumper was about 19 1/2 inches above the ground. The resultant mismatch in the heights of the bumpers allowed the truck to first contact the body of Vehicle 4 in an area that was not structurally capable of withstanding such forces. If the two bumpers had been compatible, the truck might not have overridden the automobile with the crushing effect to the top of the body of Vehicle 4 and its occupants. However, the Safety Board cannot conclude that the fatalities would not have occurred had there been bumper to bumper contact between the two vehicles.

#### Driver Supervision

Interstate carriers should closely supervise their drivers to insure that they are conforming to the hours of service regulations. Drivers who take advantage of long runs and lack of supervision create traffic hazards and should be corrected by their supervisors. It is true that drivers can falsify logs and that it takes time and effort to reconstruct actual trip conditions and travel times from receipts and waybills; however, it can and should be done. The Bureau of Motor Carrier Safety must increase its surveillance of motor carrier operations under their jurisdiction and assure that they are in compliance with

<sup>14/</sup> Evaluation of a Prototype Safety Warning System on the Gulf Freeway, op  
<sup>15/</sup> Traffic Management During Urban Freeway Maintenance Operations, op cit.

existing regulations for driver qualifications and hours of service. Resources are often not available through State law enforcement agencies or through the Bureau of Motor Carrier Safety to enforce the regulations. The carrier must accept its responsibility for the conduct of its drivers. The degree of responsibility for the safe movement of its vehicles should be paramount in a carrier's planning and operations.

The American trucking industry has an extensive safety organization dedicated to the safety of truck operations and to the improvement of driver performance. These programs include cooperative road patrols, truck-stop safety meetings, distribution of training and safety literature, and truck "rodeos." The American Trucking Associations, Inc. should make more aggressive and extensive use of these programs to improve compliance with the regulations and to provide for safer operational programs through improved supervision.

#### CONCLUSIONS

##### Findings

1. Single-lane traffic through a construction zone on I-75 southbound below the I-285 interchange resulted in a queue of vehicles in the right lane of I-285 eastbound.
2. A truck, whose driver was inattentive because of distraction and fatigue, approached the queue.
3. Low flying aircraft diverted the truckdriver's attention away from the traffic conditions as he approached the queue.
4. When the vehicles ahead of the truck stopped, the driver of the truck did not apply his brakes or make any precrash avoidance maneuvers.
5. Neither the roadway geometrics nor the condition of the truck prevented the truckdriver from successfully avoiding the standing vehicles.
6. The truckdriver was not under the influence of alcohol or drugs.
7. The truckdriver was in violation of the hours of service rules as promulgated in the Federal Motor Carrier Safety Regulations.
8. Although physically qualified, the driver was operating with a forged medical certificate.
9. The incompatibility between the automobile and truck bumpers increased the severity and nature of the automobile deformation.

10. The closing of all but one lane of traffic through the construction zone was not in compliance with FHWA recommended practices.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the truckdriver to maintain the proper level of attention to the driving task and perceive the standing vehicles on the roadway and stop his vehicle short. The Safety Board believes that the driver's inattention to the traffic in front of him may have resulted from fatigue. Contributing to the accident was the failure of the Georgia Department of Transportation to implement existing standards and guidelines for controlling traffic through construction zones, which permitted a 3 1/2-mile backup of slow moving and stopping traffic.

RECOMMENDATIONS

As a result of its investigation of this accident the National Transportation Safety Board submitted the following recommendations:

-- to the Federal Highway Administration:

"Increase its oversight function for the Georgia Department of Transportation and, if necessary, help them develop plans for maintenance and construction projects to assure compliance with FHWA standards and practices. (Class II, Priority Action) (H-78-61)

"Implement, as soon as possible, new concepts, methods, and approaches currently being developed through FHWA's Office of Research that will provide traffic management systems in construction zones more specifically tailored to urban driver information needs. (Class II, Priority Action) (H-78-62)

"Direct the Bureau of Motor Carrier Safety to increase its surveillance of motor carrier operations under its jurisdiction and assure that they are in compliance with existing regulations for driver qualifications and hours of service. (Class I, Urgent Action) (H-78-63)"

-- to the State of Georgia:

"Incorporate the policies, recommended practices, and standards contained in FHWA's guidelines and the Manual on Uniform Traffic Control Devices related to the control of traffic in maintenance and construction areas. (Class II, Priority Action) (H-78-64)"

-- the American Trucking Associations, Inc., its affiliates, and trucking company members:

Emphasize educational programs at the State, regional, and national levels to bring about a better understanding of, and compliance with, the safety regulations and safety practices of truck operators, especially small carriers performing for-hire or private carriage service. (Class I, Urgent Action) (H-78-65)

"Conduct a special study to determine if there are other techniques and programs which may be developed and utilized on an industrywide basis to improve driver knowledge and conduct. (Class II, Priority Action) (H-78-66)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING  
Chairman

/s/ FRANCIS H. McADAMS  
Member

/s/ PHILIP A. HOGUE  
Member

/s/ ELWOOD T. DRIVER  
Member

September 14, 1978

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APPENDIX

VEHICLE DAMAGE

The truck-tractor sustained minor damage in the collision. Some deformation of the front bumper and superficial damage to the fenders and grill areas resulted from the initial impact with the Vehicle 4. There was minimal damage to the truck-tractor undercarriage from the override with only minor breakage of some exposed components. The semitrailer was not damaged, and the combination unit was driven shortly after it was removed from the accident site.

Vehicle 4 was destroyed. Damage included severe rotational deformation at the rear of the vehicle. Rear end components (bumper, kamback door, rear axle, etc.) were deflected upward and toward the front of the vehicle. The occupant compartment integrity was completely violated by both the rear rotation and crush as well as the forward and downward folding of the rear two-thirds of the roof.

A horizontal indentation across the rear kamback door 8 1/2 inches above and down to the bottom door edge at the bumper was observed. Two triangular patterns of three intrusion dents were located within this indentation. The configuration of these indentations corresponded exactly to the pattern of the fasteners securing the truck-tractor's front bumper to the side rails.

The camper-trailer towed by Vehicle 3 was destroyed. The trailer body side-panels separated, the top elevated and the frame deformed as a result of the rear impact. The forward acceleration of the trailer into the towing vehicle caused the trailer tongue to penetrate the area under the rear bumper, through the license plate and over the gas tank to a point approximately 2 feet forward of its original position.

A DOT-4BA240 (5.73 gallon) liquified petroleum gas (LPG) tank similar to the one studied in a Safety Board Report <sup>1/</sup> was mounted on the trailer frame rail extension between the rear of the automobile and the body of the camper-trailer. The penetration of the trailer tongue reduced the space between the vehicle and the trailer bodies. The tank, which initially occupied this space, was subjected to compressive forces front and rear. Those forces resulted in deformation of the tank valve's protective collar, rupture of the fuel line between the tank valve and the regulator, and subsequent release of the tank from its mounting. Despite the rupture and complete separation of the fuel line near the tank valve, no LPG leaked following the accident. The vehicle owner/operator had taken the precaution of closing the valve while the camper unit was in transit.

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<sup>1/</sup> Highway Accident Report - Collision of Winnebago Motor Home with Bridge Column, near Monroe, Michigan, July 1, 1975. National Transportation Safety Board, Report Number NTSB-HAR-76-2. March 3, 1976.

Damage to Vehicle 3 included deformation at both front and rear of the vehicle. The impact of the towed trailer with the rear of the vehicle described previously resulted in little sheet metal damage. The penetration of the trailer-tongue did, however, cause fuel tank rupture and buckling of the trunk floor. Although considerable fuel was spilled, no fire resulted. Additionally, the secondary impact of Vehicle 3 with the rear of Vehicle 2 resulted in minor frontal sheet metal damage to Vehicle 3.

Damage to Vehicle 2 included full-width crush of the rear engine compartment area which resulted in engine and drivetrain damage. Damage to Vehicle 2 front and rear right side fenders was due to the sideswipe-like collision with the trailer towed by Vehicle 1.

Vehicle 1 was also towing a "pop-up" style camper-trailer. The sideswipe by Vehicle 2 left a paint transfer only on the left rear trailer bumper. There was no damage to the automobile.