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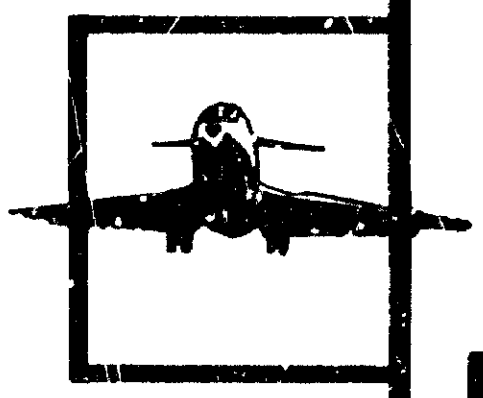

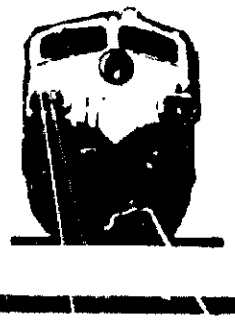

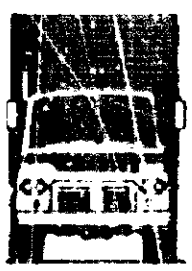

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

OVERTURN OF A YPSILANTI, MICHIGAN, BOYS CLUB BUS, ON I-75, NEAR TIFTON, GEORGIA APRIL 11, 1978

UNITED STATES GOVERNMENT

TECHNICAL REPORT DOCUMENTATION PAGE

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16. Abstract

About 10:00 a.m., April 11, 1978, a "schoolbus" type bus, occupied by 56 boys and 2 adults, was southbound on I-75 near Tifton, Georgia, en route to Disney World, Florida, from Ypsilanti, Michigan. The bus was being operated by the Ypsilanti Boys Club. As the bus exited I-75 at a safety rest area, it went off the road while negotiating a right curve on the exit lane, overturned, and struck a tree. Three passengers were killed, and the driver and 25 passengers were injured.

The National Transportation Safety Board determines that the probable cause of the accident was the driver's loss of directional control of the bus on a curve because of excessive speed due to the failure of the accelerator return spring, which resulted from improper maintenance. Contributing to the accident were severely underinflated tires, deteriorated suspension, excessive luggage on the roof, and driver fatigue.

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NATIONAL TRANSPORTATION SAFETY BOARD
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HIGHWAY ACCIDENT REPORT

Adopted: March 8, 1979

OVERTURN OF A YPSILANTI, MICHIGAN, BOYS CLUB BUS
I-75, NEAR TIFTON, GEORGIA
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SYNOPSIS

About 10:00 a.m., April 11, 1978, a "schoolbus" type bus, occupied by 56 boys and 2 adults, was southbound on I-75 near Tifton, Georgia, en route to Disney World, Florida, from Ypsilanti, Michigan. The bus was being operated by the Ypsilanti Boys Club. As the bus exited I-75 at a safety rest area, it went off the road while negotiating a right curve on the exit lane, overturned, and struck a tree. Three passengers were killed, and the driver and 25 passengers were injured.

The National Transportation Safety Board determines that the probable cause of the accident was the driver's loss of directional control of the bus on a curve because of excessive speed due to the failure of the accelerator return spring, which resulted from improper maintenance. Contributing to the accident were severely underinflated tires, deteriorated suspension, excessive luggage on the roof, and driver fatigue.

INVESTIGATION

The Accident

About 10:00 a.m., e.s.t., 1/ Sunday, April 9, 1978, two "schoolbus" type buses departed Ypsilanti, Michigan, en route to Florida. When they departed, there were 35 boys and 2 adults in 1 bus, and 37 boys and 2 adults in the other; the boys were aged 11 to 17. The trip was being sponsored by the Ypsilanti Boys Club. Organizers had planned to drive "straight through" and to arrive in Florida on Monday about 12 noon.

About 2 p.m., 4 hours after leaving Ypsilanti, one of the buses developed a transmission problem. After a 2- to 3-hour delay, they continued on to Dayton, Ohio, where they stayed overnight while plans were made to replace the disabled bus.

On Monday, April 10, while the boys were taken to an Air Force Museum in Fairborn, Ohio, a passenger van was obtained to replace the bus. Since the van was smaller than the bus, the boys and their luggage

1/ All times herein are eastern standard.

were redistributed. Two adults and 16 boys were assigned to the van, and 56 boys and 2 adults to the remaining bus. All luggage was put on a luggage rack on the roof of the bus, and all sleeping bags were put inside the bus in overhead racks. About 5:00 p.m., the bus and van departed Dayton. The bus was the lead vehicle.

About 7:20 a.m., April 11, near Macon, Georgia, the relief busdriver became tired and made an unscheduled stop at a rest area so that all the drivers could rest. The busdriver, however, said that she wasn't tired and would continue driving.

Various stops and driver changes were made during the trip from Ypsilanti; however, this one driver did most of the driving of the bus. (See figure 1.)

About 10:00 a.m., 100 miles south of the Macon rest stop on I-75, near Tifton, Georgia, the van driver became tired and wanted to switch with his relief driver. He saw a sign indicating a rest area 2 miles ahead and decided to make a driver change there. Since this was not a scheduled stop, the van passed the bus and with its right turn signal flashing exited at the rest area; the busdriver activated her right turn signal and followed. The vehicles were traveling about 50 to 55 mph. After a 735-foot straight tapered section, the exit ramp curved right at 27°30' (208-foot radius). As the bus attempted to negotiate the curve, it yawed clockwise, crossed the left shoulder onto a grass embankment, rolled over onto its left side, and slid roof-first into a tree. (See figures 2, 3, 4, and 5.)

The busdriver stated that she steered onto the exit lane at its beginning; at that time, she took her foot off the accelerator and pumped the brakes, but the bus did not decelerate. She was adjacent to the rest area exit sign when she pumped her brakes for the first time at the exit ramp. (See figure 2.) She exclaimed to her relief driver, who was standing in the front of the bus at the glove compartment, "the brakes...," and then braked again as she started into the curve. She claimed that the brakes did not work. She stated that at the beginning of the curve the bus was going about 35 to 40 mph and was four to six car-lengths behind the van.

The relief driver stated, "I felt the bus slow down, and looked up to ask why we were stopping, and I saw the van pulling off into the rest area, it was just into the turn and we were 50 to 100 feet behind. We hadn't hit the turn yet when the driver yelled out that she didn't have brakes. I said, 'they're not catching.' She then steered into the turn and the bus turned over."

The driver of the van stated, "When the bus started into the curve I heard the tires squealing, I looked back and saw it hugging the shoulder of the road; at that time I knew something was wrong. She was trying to keep it on the road, but she couldn't."

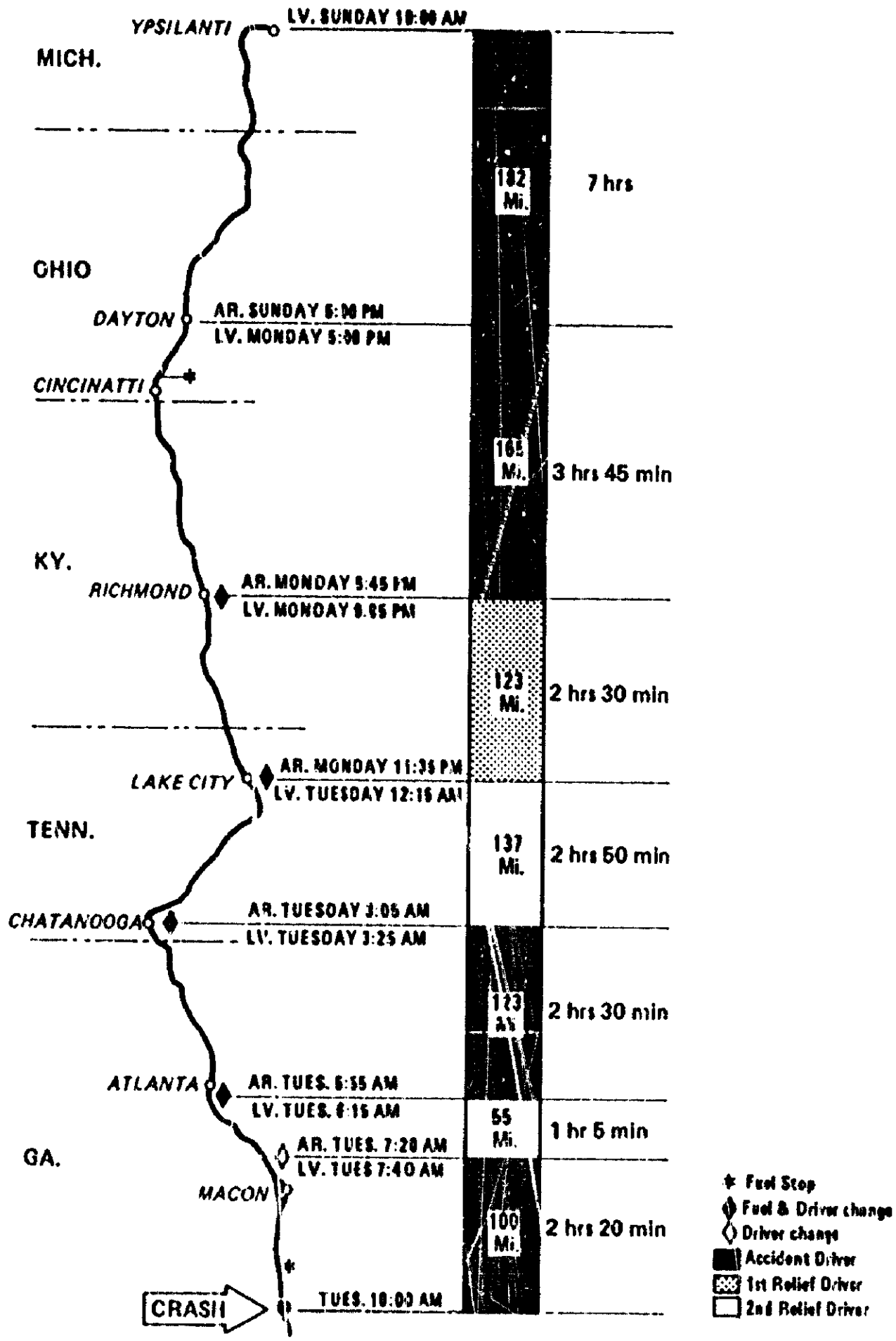

Figure 1. Estimated trip time-distance relationship.

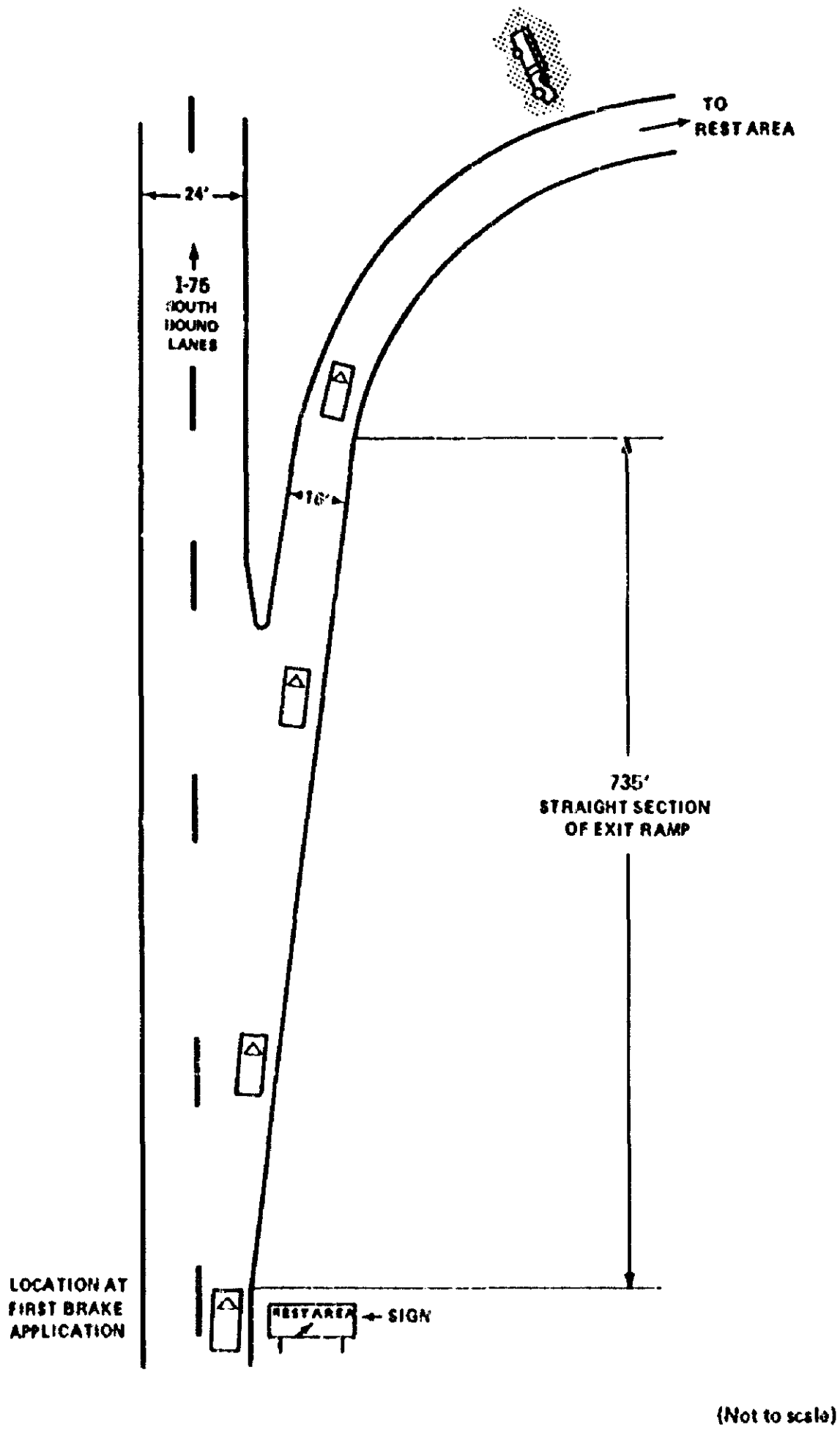

Figure 2. Path of bus on exit ramp.

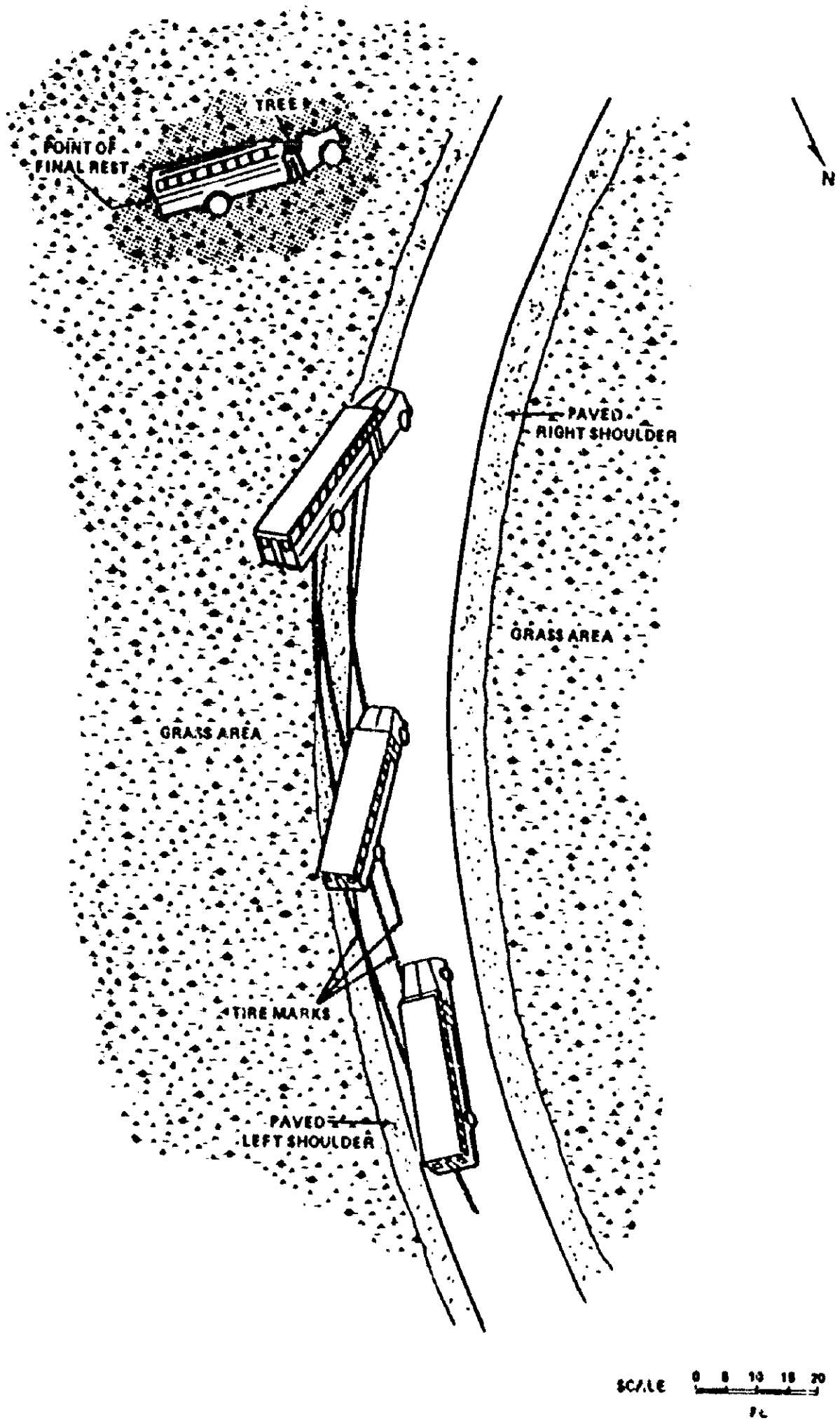

Figure 3. Path of bus.

Figure 4. Frontal view of overturned bus at final rest.

Firgure 5. Foreground shows luggage that had been on the roof of the bus.

The last time the busdriver had used the brakes was when she had slowed at a road construction site several miles before the accident and they worked properly. The two other drivers who had driven the bus during this trip said that they had not experienced any braking problems. All stated that the brakes were working properly when they were driving the bus.

The accident occurred during daylight hours; the sky was clear and the road was dry.

Injuries to Persons

Injuries	Drivers	Passengers
Fatal	0	3
Nonfatal	1	25
Minor/None	0	29

Vehicle Information

The bus, owned by the Ypsilanti Boys Club of Michigan, was purchased new in 1967. It was composed of a model C7-2900 Wayne body mounted on a 1967 Chevrolet, model SE63102, two-axle schoolbus chassis with dual tires on each rear wheel. All tires were size 9:00 x 20 with a 10-ply rating. The bus was powered by an 8-cylinder gasoline engine which was governed at 4,000 rpm and had a 5-speed manual transmission and power steering. The odometer reading was 58,590 miles. The gross weight of the bus at the time of the crash was estimated to be about 19,400 lbs.

The bus, bearing Michigan schoolbus license plates, was painted chrome yellow with black trim. It was equipped with 21 bench-type seats, providing a seating capability of 63 children. There was one folding entrance/exit door at the right front of the bus and one emergency door at the rear.

The bus was equipped with vacuum-booster hydraulic brakes. The front axle had 15- x 3-inch brake linings and brakedrums, and the rear axle had 15- x 6-inch brake linings and brakedrums. The parking brake was a mechanically operated, drive-shaft, drum-type brake, mounted on the rear of the transmission; the hand lever was located on the right side of the steering column, suspended below the dash board.

The bus was damaged substantially when it struck the tree. The roof of the bus was crushed laterally in a downward direction from the windshield to the third roof panel. The first two roof panels had collapsed completely when they came in direct contact with the tree. The left side of the roof was crushed downward about 4 feet; a side window was crushed down to sill level, and the side-body panels below

the sill were buckled. (See figure 6.) The collapse damage continued along the roof laterally, increasing to about 6 1/2 feet deep on the right side where the roof, side window, and side-body panels were crushed to the floor; the two chassis frame rails below this area were collapsed downward. (See figure 7.) The windshield and right side folding door had collapsed downward and toward the rear; all glass was missing. The glass from the rear windows and rear emergency door was also missing. Several riveted roof panel seams had failed partially and one seam, which had connected the third and fourth roof panels, had failed completely. The 30-gallon gas tank, located on the right side below the floor in the area of the collapsed chassis rail, was not damaged and no fuel leaked. The exhaust pipe near the midsection of the bus separated at a connecting joint.

Within the bus, the first two benches on each side were bent and twisted as a result of the roof's collapsing onto them; all other bench frames and anchorages remained intact. Passenger seat cushions, which had been attached to the bench frames by metal clips, were dislodged and scattered about the interior; the bench back cushions remained intact. The drivers seat cushion and back cushion were separated from the frame; the attachment clips were missing from the cushion. The sheetmetal interior luggage racks, suspended from the ceiling above the benches on each side of the bus, were bent downward in the area of the collapsed roof and were indented upward in several places to the rear of the collapse.

A postcrash inspection of the bus revealed that the brakedrums and brake linings had no defects that would have affected the braking capability at the time of the crash. The left rear brakedrum and brake linings were oil soaked at the time of inspection, but the source of the oil was traced to the differential. It had leaked through a vent on the left rear axle housing while the bus was laying on its left side. The cap was missing from the vent oriface.

The following deficiencies were discovered during the postcrash vehicle examination:

1. Foot-brake pedal travel, measured with the engine running, was 6 1/4 inches, 2 1/4 inches beyond the 4-inch manufacturer's recommended maximum. At full force application the brake pedal stopped 3/16 inch from a metal heater pipe that was installed against the firewall behind the brake, clutch, and gas pedal. The brake lining to brakedrum clearance at the front wheels was .030 inch; at the right rear wheel, it was .16 inch: and at the left rear wheel, it was .125 inch. The maximum clearance suggested by the manufacturer is .040 to .045 inch.

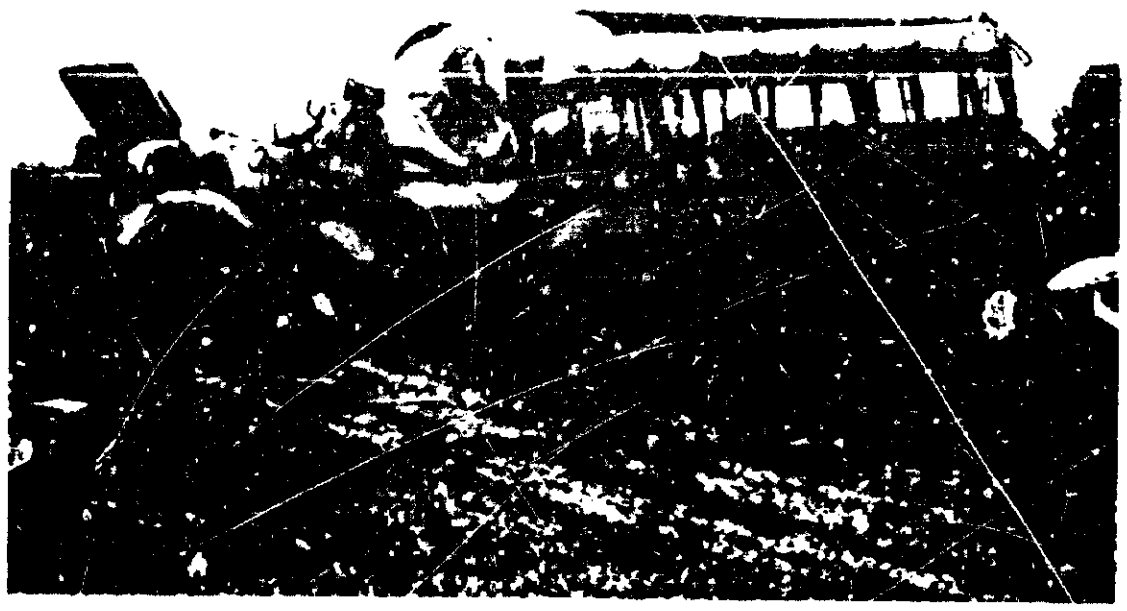

Figure 6. View of the left side of the bus.

Figure 7. View of the right front side of the bus.

2. The parking brake was out of adjustment and when tested provided no braking torque.

3. The right rear spring had three fractured leaves -- leaves three, four, and five. Leaves three and five were fractured on boths sides of the spring clips; three fractured sections were missing. (See figure 8.) All fractured leaf ends were rusted, except for the fourth leaf.

4. Tire air pressure was: Left front tire -- 36 psi, right front -- 34 psi, left rear tires -- 42 and 46 psi, and the right rears -- 52 and 64 psi. The tire pressure recommended for these tires was 75 psi for the front tires and 70 psi for the dual rear tires. 2/

5. The accelerator return spring was missing from the carburetor and was found in the engine compartment with one end fractured. The spring is normally attached between the throttle lever on the carburetor and an anchoring device on the thermostat housing. (See figure 9.) The spring anchoring device was missing from the thermostat housing. This spring is a vital part of the accelerator linkage assembly and provides the tension that returns the throttle to idle when a driver removes the actuating force from the gas pedal. If the spring is not in place, the throttle will remain in a "wide open" position.

Vehicle Maintenance

In January 1978, a driver reported to the Boys Club that the accelerator return spring was "getting sloppy; there was no tension and the gas pedal was not returning properly." When he drove the bus a couple of weeks later the gas pedal returned immediately, and he assumed that the spring had been replaced. However, examination of the spring, available maintenance records, and witness statements indicate that it had not been replaced.

The Boys Club did not have any procedure or schedule for servicing the bus and no preventive maintenance was conducted. The director stated that the bus was taken in for repairs "...when we realize something is wrong." He also stated that, on occasion, before they went on trips, the bus would be taken in for a check.

He said that in March 1978, when the bus was taken to a Chevrolet Service Center to repair the clutch, the mechanic was told to "check the bus out because we are going on a trip." The Center's service manager disclaimed this allegation and stated that the work requested by a

2/ 1972 Tire and Rim Association Year Book.

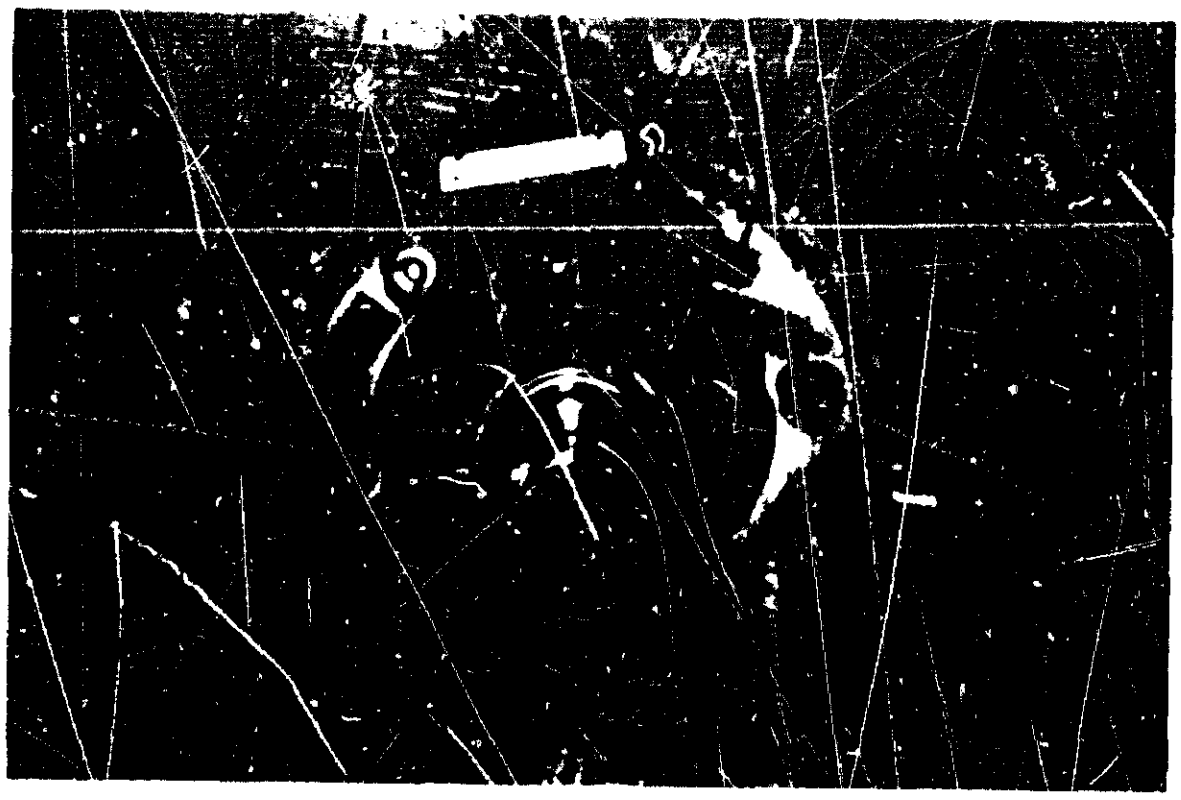

Figure 8. View of right rear spring arrows indicate fractured leafs.

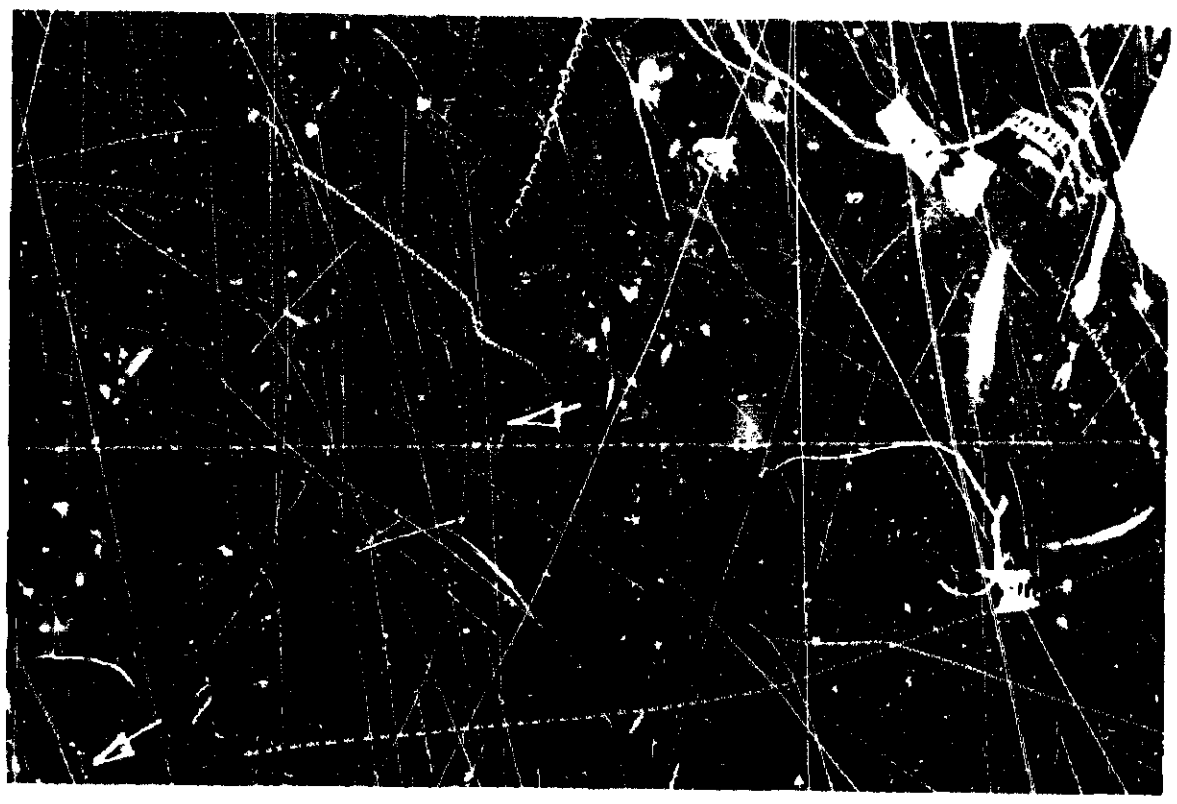

Figure 9. View of carburetor showing absence of return. Arrows No. 1 and No. 2 indicate points at which the accelerator return spring would normally be attached.

customer is recorded on the service receipt, which is signed by the customer. If the customer had requested an inspection, it would have been recorded on the receipt. The repair receipt was examined and no instructions to inspect the vehicle were noted.

Except for five receipts for repairs made between August 1977 and March 1978, no records relating to the bus were maintained.

Driver Information

The 24-year-old driver was employed by the Ypsilanti Boys Club in 1975 as a Unit Director; her duties included driving a bus. She held a valid Michigan State chauffeur's license that authorized her to drive this type vehicle; there were no restrictions. A check of her driver file revealed that she had no record of previous accidents or traffic violation convictions.

The driver had received no formal busdriver training. She was taught to drive the bus by another Boys Club employee. She had been driving the bus since September 1975. She normally drove 2 hours daily from Tuesday through Friday during the school year. She picked up Boys Club members in the afternoon at their schools, took them to the Boys Club, and took them to their homes in the evening. She has previously driven the bus on club trips to Chicago, Illinois, and Springfield, Massachusetts.

Although other employees occasionally drove the bus, this driver had been the principal driver for the past 2 years and shared the bus maintenance responsibility with the director.

During the 24 hours before the accident, the busdriver's activities included taking the boys to the Air Force Museum in Fairborn, Ohio. She drove the bus both ways, a total distance of about 20 miles. From 5:00 p.m. to the crash, she had driven an additional 388 miles for a 24-hour total of about 408 miles. During this period, she slept 1 1/2 to 2 hours while seated on one of the passenger benches in the bus as the bus was driven by her relief driver from Lake City, Tennessee, to Chattanooga, Tennessee.

Roadway Information

At the accident site, about 15 miles north of Tifton, Georgia, I-75 was a straight, concrete, 4-lane divided highway with a posted 55-mph speed limit and a 40 mph minimum speed limit. The southbound roadway was 24 feet wide, delineated as two lanes with a 10-foot-wide, paved, bituminous right shoulder, and ascended at a +1.6-percent grade.

A single lane exit ramp to safety rest area No. 9 departed from the right edge of the southbound through lanes at an angle of 5°. After a straight 735-foot-section, the ramp curved right 27° 30' (208-foot radius). The curve was banked and had a maximum superelevation of .08 feet per foot, which was achieved at the center section of the curve.

The exit lane became 16 feet wide after a 257-foot-long transition taper from the through lanes. The exit ramp maintained a +1.5-percent grade for about 500 feet, followed by a 100-foot crest, vertical curve, and then maintained a +.16-percent grade to the approximate end of the curve.

The exit ramp surface was concrete and had a 6-foot, paved, bituminous right shoulder and a 4-foot, paved, bituminous left shoulder that began after the exit gore nose. The grass embankment adjacent to the left shoulder had an 18-percent downward slope; the total change in height was about 5 feet. Solid white edge lines delineated the exit ramp but ended at the beginning of the curved section. There were no painted edge lines on the curved section of the exit ramp. (See figure 10.) Continuation of solid white pavement edge lines through the curve and length of the exit ramp would provide additional guidance for drivers.

A white painted, straight arrow, 10 feet long and accentuated with crystal, high-intensity, raised pavement markers, was located in the center of the roadway, 95 feet after the curved portion of the exit ramp began. The arrow points in the travel direction.

Although the Georgia Highway Department's Sign Plan specifies placement of a ramp speed sign on the right shoulder 244 feet before the point of curvature, such a sign was not in place at the time of the crash. Maximum recommended speed would have been 25 mph. On April 13, 1978, the Georgia Department of Transportation District Traffic Engineer recommended that "chevron" signs be placed around the curve on the exit to Safety Rest Area No. 9 (see figure 9a) and that 25-mph advisory exit speed signs be installed on all five exit ramps in District No. 4. At the time of the crash, there were no traffic-control signs facing traffic on the exit ramp. A guide sign stating "rest area" with a 45° arrow indicating the appropriate turn was in place on the right shoulder 22 feet north of the beginning of the exit ramp.

Since the crash, the recommended signs have been installed. Additionally, an audit was made of all similar locations in the State to insure that appropriate signs had also been installed at those sites.

Tire marks, apparently made by the bus, were found on the curved section of the exit ramp. (See figure 11.) They began in the road about 100 feet past the point of curvature and continued in a curved path across the paved left shoulder. Two of the tire marks ended at the shoulder edge; the third continued as a furrow onto the grass embankment

Figure 9a. Chevron alignment sign intended to provide additional emphasis and guidance for vehicle operators as to changes in horizontal alignment of the roadway.

for 36 feet before ending. Shortly after the tire furrow in the dirt ended, a broad area of surface scrapes began in the grass area and continued about 40 feet. They ended at a 1.5-foot-diameter pine tree, located 27 feet from the exit ramp. The bark on the northeast side of the tree had been torn off to a height of 8 feet. A circular area of oil was found on the grass in the area of the damaged tree.

Survival Aspects

The van drivers and the busdriver began rescue efforts immediately after the crash. All but five passengers were evacuated within a short time, most of them through the emergency door window in the rear of the bus. The emergency door could not be opened because the frame had been distorted during the crash.

Police and emergency medical technicians arrived 5 to 10 minutes after the crash and assisted in extricating the last five boys who were trapped under the crushed roof. These boys were removed through the front windshield after the bench frames were disconnected. Three of the five boys died and two were injured seriously.

Other Information

In March 1969 a recall campaign was conducted by General Motors Corporation (GMC) involving this model vehicle. The recall required three modifications: (1) Replace flexible vacuum brake line hose with combination steel and flexible line; (2) overhaul brake master cylinder, replacing parts as specified; and (3) install new hydraulic brake pipes with support bracket. GMC records and a Safety Board inspection indicated that all the required modifications had been made.

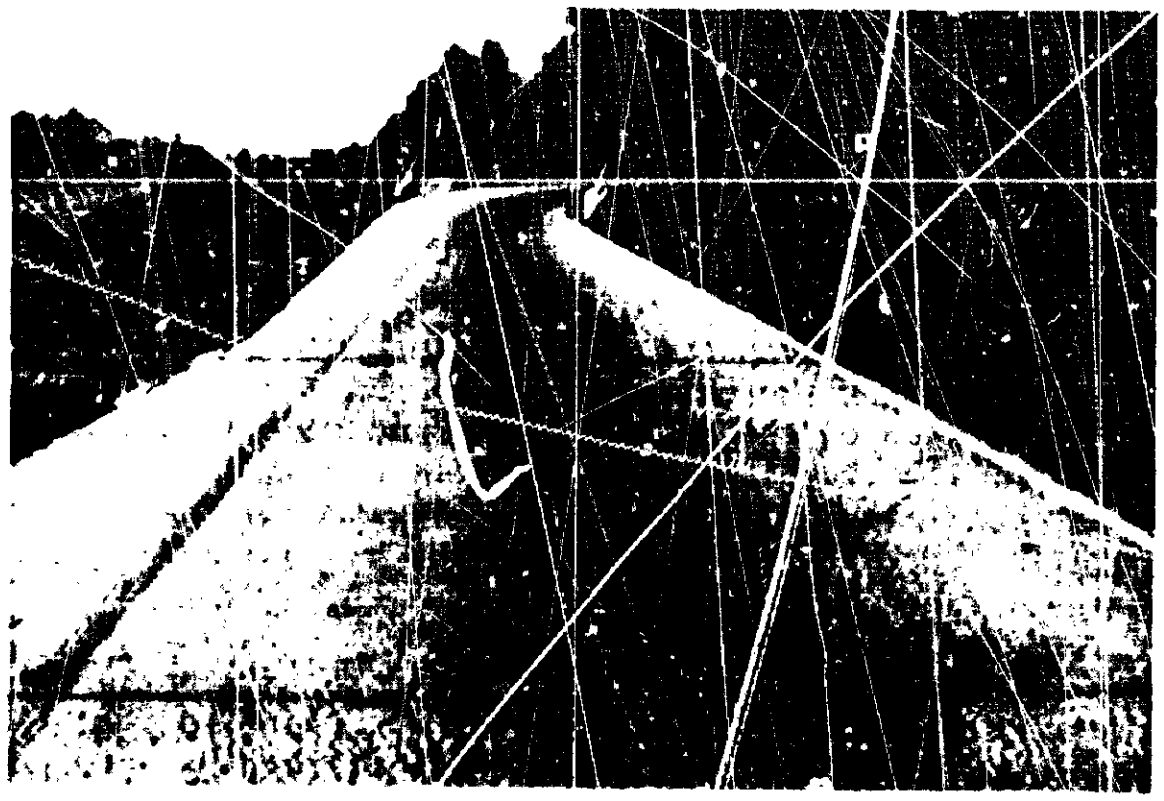

Figure 10. Exit ramp approach to curve.
1. Where white edge lines end.
2. Where bus struck tree.

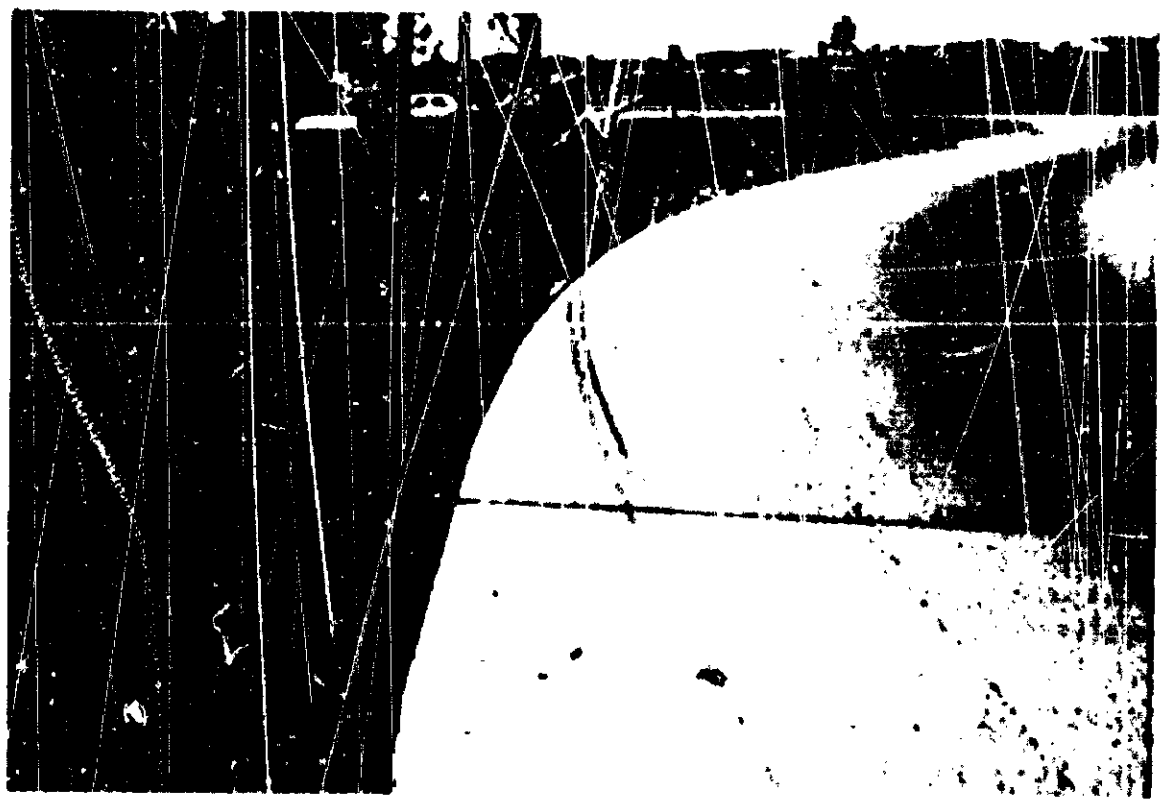

Figure 11. Tire marks at scene.
Arrow indicates tree that was struck.

Tests and Research

Brake test. -- A Safety Board investigator tested the bus brakes by driving 10 mph on a dirt road, placing the transmission in neutral, and fully applying the brakes. Three wheels locked and the bus skidded to a straight stop. The brake linings and brakedrum on the left rear wheel were soaked with differential oil, and therefore, the left rear wheel did not lock.

Skid test. -- Safety Board investigators used a passenger sedan to conduct a skid test on the exit ramp. The sedan was driven at 30 mph on the straight section of the dry exit ramp and braked to a halt with all wheels locked. The coefficient of friction computed from this test was 0.68. This coefficient of friction was adjusted to the bus tires 3/, and the critical speed of the curve for the bus was calculated to be 40 to 43 mph.

Accelerator return spring. -- The National Transportation Safety Board's Metallurgical Laboratory analyzed the fractured accelerator return spring. The analysis indicated that the spring had fractured transversely in an area used for the attachment of one end. (See figure 12.) This area appeared to be where the spring wire began to bend, forming a hook similar to that on the other end. (See figure 13.)

Examination of the fracture disclosed fracture features typical of fatigue over 60 percent of the fractured cross-section. The origin of the fatigue crack was located along the inner radius of the bend as shown by arrow "O" in figure 13. Fatigue had propagated out to the position indicated by the arrows in figure 14. An area showing fracture features indicative of fatigue is displayed in figures 14 and 15. The remaining fracture outside of this fatigue region was typical of an overload separation.

The fatigue area of the fracture was masked by a deposit having a chemical composition similar to that of a deposit which coated the outside diameter of the wire adjacent the fracture. The deposit, believed to be an oxide produced by corrosion, became thinner with distance away from the origin. Little of the substance was deposited toward the end of the fatigue crack.

The hooked end of the spring was visibly corroded. The spring contained particles of grey paint in some areas, suggesting that it had been painted. There was no paint on the hooked end or in the area of the fatigue crack.

3/ Based on information contained in Department of Transportation Study HS 801-141, December 1976.

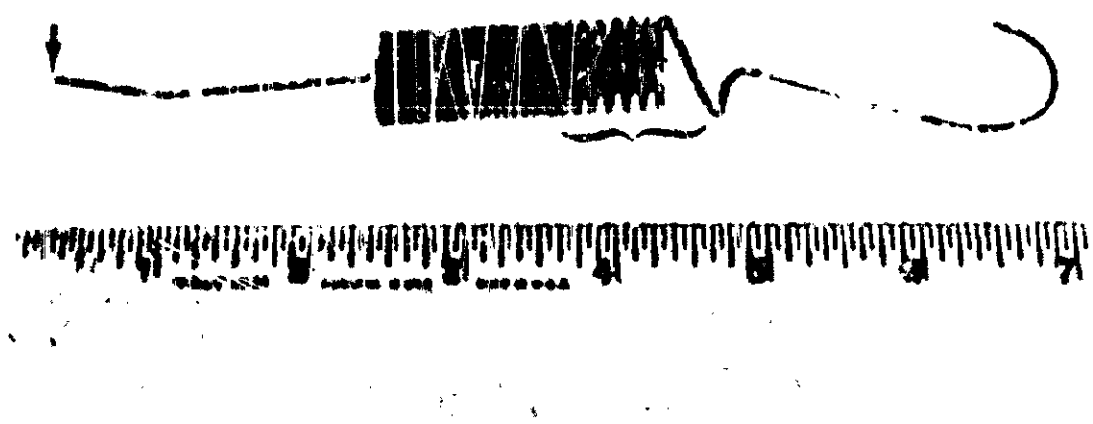

Figure 12. Overall view of the carburetor return spring. Arrow locates fracture and bracket denotes extended coils.

Figure 13. Magnified side view of spring wire at fracture showing location in reference to bend. "O" denotes origin area. X20

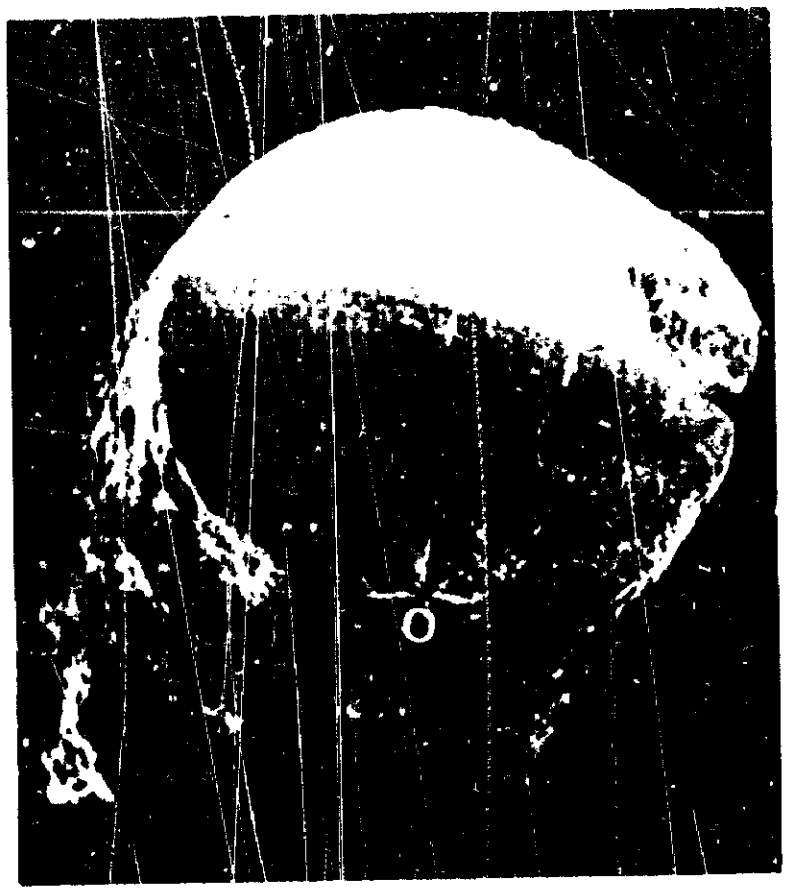

Figure 14. Fracture surface of spring break. "O" denotes fatigue origin area and arrowheads depict extent of fatigue cracking from the origin. X50

Figure 15. Highly magnified view of fracture surface in the fatigue region near the terminus of the fatigue crack. Arrow denotes direction of fatigue crack propagation. X2000

Michigan Vehicle Code

"§9.1857 Schoolbus. Sec. 57. 'Schoolbus' means every motor vehicle [except station wagons] with a manufacturers' rated seating capacity of [8] or more children owned by a public, private or governmental agency and operated for the transportation of children to or from school, or privately owned and operated for compensation for the transportation of children to or from school: provided, that the term schoolbus shall not include buses operated by a municipally owned transportation system or by a common passenger carrier [certificated] by the public service commission."

"§9.2005.(1) Driver of public schoolbus; course in schoolbus safety; consequences of failure to complete; commercial bus companies, exception. Sec. 305a. A driver of a public [or nonpublic] schoolbus shall have in his possession a certificate stating he has been enrolled in or has completed a course in schoolbus safety education conducted during or not more than 2 years prior to the school year in which he drives a schoolbus. The course shall be approved by the superintendent of public instruction and shall be provided by an intermediate school district or a State university.... Failure to complete the course shall be reported by the instructor to the department of education and to the school in which the busdriver is employed. A driver who fails to complete the course within the school year in which he is enrolled shall not be permitted to drive a bus."

"§9.2415(b) Motor Vehicle Inspection.

The director of the department of State police shall cause inspection to be made of motor vehicles operating on the public highway to detect defective equipment or other violations of law governing the use of public highways by motor vehicles, operators and chauffeurs."

Michigan School Code of 1976

§15.41343 Safety specifications for schoolbus. Sec. 1343. (1) The State board shall promulgate rules for safety specifications for schoolbuses transporting pupils to public and nonpublic schools.

Inspection of buses. (2) The department of State police shall inspect each schoolbus annually, and more frequently in a school district where bus defects have been found, to determine if the bus meets the specifications of the State board. The department of State police may delegate the inspection of schoolbuses to publicly employed inspectors if the inspection complies with this section.

§15.41344 Painting of schoolbus; colors; district name. Sec. 1344. (1) Each schoolbus purchased or repainted shall be painted, with the exception of trim, national schoolbus chrome yellow, as specified by the national bureau of standards specification. Body trim, if used, shall be black. The name of the school district shall be painted in black on the back, front, and sides of the bus.

Colors and designs, restrictions. (2) A bus, not engaged in the transportation of school pupils, either part-time or full-time, shall not be painted in colors and design specified in subsection (1).

Enforcement. (3) The State board and law enforcement officers shall enforce the requirements of this ection.

ANALYSIS

The Accident

Evidence indicates that at, or shoftly before, the exit ramp, the accelerator return spring failed permitting the accelerator to remain in a "wide open" position. As a result, the bus maintained its maximum governed speed after the driver had removed her foot from the accelerator. When the driver applied the brakes to slow the bus, there was some deceleration, but the bus did not decelerate as it normally would because it was braking against an engine which was operating at its maximum governed speed. Since the bus did not slow as the driver had expected, the sensation experienced by the driver when she applied the brakes was that "nothing happened."

The Safety Board believes that the driver was fatigued, and as a result, did not detect that the engine did not throttle down when she removed her foot from the accelerator. Although there was about 700 feet of roadway from the point of first brake application to the point of curvature, the driver made no attempt at any evasive action other than to apply the brakes which she already concluded had failed. The driver's evasive action could have included turning off the ignition, down shifting to a lower gear, or steering back onto the highway before reaching the gore area.

Although the speed of the bus as it began to negotiate the curve could not be determined, the Safety Board believes that, since the radius tracked by the bus was larger than that of the road curvature, the bus was exceeding the critical speed of the curve. As a result the driver lost directional control and the bus went off the road and overturned.

Underinflated tires, the luggage on the roof, and the poor condition of the rear suspension all contributed to the poor handling characteristics of the bus and could have created an oversteer condition. The extent to which these contributed to this accident could not be fully determined. The lack of traffic signing and extended roadway edge line markings did not contribute to this accident.

The return spring is normally attached between the throttle lever on the carburetor and an anchoring clip attached to the thermostat housing. Evidence indicates that the spring had previously lost some of its tension and that the anchored end had been removed from the thermostat housing and stretched to another location to provide increased tension.

Analysis of the fractured spring indicates that the complete fracture was imminent on continuing fatigue cycles and probably failed as a result of fatigue stresses. The primary stress promoting the fatigue was bending or tension, or both, produced during extension of the spring. Extension of some of the coils suggest that the spring was manually stretched.

Any stress placed on the spring during the crash would not have been significant; the spring would have been in a relaxed state because of the lack of accelerator pedal pressure. Engine movement during the overturn and subsequent collision would not increase the spring tension because the spring was apparently attached to two points on the engine and would move with the engine. Therefore, the Board concludes that the spring failed under tension before the crash.

In 1973 the National Highway Traffic Safety Administration (NHTSA) adopted Federal Motor Vehicle Safety Standard (FMVSS) 124, which established requirements for the return of a vehicle throttle to the idle position when the driver removes the actuating force from the accelerator control, or in the event the accelerator control system is severed or disconnected. Had this standard been in effect when this bus was manufactured, the accident may have been avoided.

The Brakes

Although the busdriver believed that the brakes had failed, the physical evidence does not support her belief. Three drivers, including the accident driver, who had driven the bus within 12 hours of the crash, which included driving and braking in mountainous areas, stated that the brakes were working properly. The accident driver said she had last used the brakes to slow the bus at a road construction area a few miles before the crash and had last braked the bus to a stop when the bus was refueled about 45 miles before the crash. Braking problems were not experienced on either occasion.

Tire marks at the crash site indicated that there was some braking, and a postcrash inspection of the brakes and a brake test revealed that the brake system was intact and functioning. The excessive brake-pedal travel was caused by the excessive clearance between the brake linings and brakedrums, particularly at the rear wheels. Although brake-pedal travel was found to be excessive, it did not have any significant effect on braking torque. It did, however, indicate that brake maintenance was

required. There are imminent dangers associated with excessive brake pedal travel, the most obvious of which is a lack of reserve brake pedal stroke to compensate for brake fade when brakes heat up or when brake linings wear. Although neither of these had manifested themselves, they eventually would have because of the remiss maintenance practices, particularly since there was only 3/16 inch clearance at maximum brake application between the brake pedal and a heater pipe that traversed the firewall behind the pedal.

Vehicle Maintenance

The Michigan School Code of 1976, Section 15.41343, which mandates the annual schoolbus inspection, states in subdivision (1), "The State board shall promulgate rules for safety specifications for schoolbuses transporting pupils to public and nonpublic schools." Since the accident bus did not transport pupils to school, it does not satisfy the requirements of the school code and would not have to be inspected. Two State officials stated that the accident bus was not considered a schoolbus.

Since Michigan State Vehicle Code and Michigan School Code 1976 are imprecise and ambiguous, the State of Michigan has evidently determined that this bus was not a schoolbus and did not require that the bus be inspected. Therefore, the responsibility for its mechanical condition rested solely with the driver and the Director of the Boys Club. Neither person maintained the bus properly, as evidenced by the lack of maintenance records, lack of a maintenance program, and a failure to recognize the most apparent discrepancies, such as the excessive brake pedal travel, inoperative parking brake, improper tire inflation, and broken spring leaves. Their maintenance policy consisted of repairing the bus when they realized something was wrong. This indeed was a hazardous maintenance philosophy to adopt, because it permitted components to deteriorate to the point of failure before any maintenance was performed. The accelerator spring failure is a tragic example.

The State of Michigan has adopted a random spot inspection procedure for inspecting motor vehicles and does not require a periodic motor vehicle inspection, except for schoolbuses, which must be inspected annually.

The Safety Board finds that Michigan's definition of a schoolbus is precise. Section 9.1857 of the State Motor Vehicle Code defines schoolbuses. Since this bus was used to transport children from school, it falls under the requirements of the Code, which requires an annual State inspection and a certificate to indicate that the driver has either completed or is enrolled in a schoolbus safety course. In addition, the bus displayed schoolbus registration plates and was painted chrome yellow with black

trim. Section 15.41344 of the Michigan School Code of 1976 reserves these colors for schoolbuses and, further, prohibits any bus not engaged in the transportation of school pupils, either part-time or fulltime, to be painted these colors.

However, since the Michigan School Code of 1976 does not clearly establish that this bus was a "schoolbus," a situation exists where buses regularly used to transport children elude State motor vehicle inspections for the service life of the vehicle. The use of this type of bus in similar operations requires closer scrutiny to insure maximum safety to the children being transported.

Although the weakened, fatigued accelerator return spring probably would not have been discovered through a periodic State-required vehicle inspection, a properly designed vehicle maintenance program should have identified the weakened spring and caused it to be replaced.

CONCLUSIONS

Findings

1. The accelerator return spring failed before the accident permitting the throttle to assume a "wide open" position.

2. The driver did not recognize the failure of the accelerator return spring and did not react to the condition.

3. The driver was fatigued because of a lack of proper and adequate sleep.

4. The brakes were less effective when working against an engine at full throttle.

5. The driver lost directional control of the bus because it was traveling at an excessive rate of speed when negotiating the curve.

6. The extent to which the underinflated tires, poor condition of the rear suspension, and luggage on the roof contributed to this accident could not be fully determined.

7. The service brake system was intact and functioning although there was excessive brake pedal travel.

8. The bus was not properly inspected before the trip and effective maintenance was not practiced.

9. The exit ramp lacked appropriate signing, but this was not causal to the crash.

10. The lack of a specific definition of a schoolbus in the Michigan schoolbus inspection laws permitted a situation wherein responsible persons were not required to have the bus properly inspected.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the driver's loss of directional control of the bus on a curve because of excessive speed due to the failure of the accelerator return spring, which resulted from improper maintenance. Contributing to the accident were severely underinflated tires, deteriorated suspension, excessive luggage on the roof, and driver fatigue.

RECOMMENDATIONS

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

-- to the State of Michigan

"Provide at least an annual motor vehicle inspection program for vehicles that seat 10 or more persons and buses that are not presently required to be inspected. (Class II, Priority Action) (H-79-8)"

-- to the State of Georgia

"Continue pavement edge lines through the length of an exit ramp at locations where these lines have been terminated prior to the ramp's ending. (Class II, Prioirty Action) (H-79-9)"

-- to the National Highway Traffic Safety Administration

"Request that the individual States identify individuals or groups in the State that transport persons on a nonscheduled, not-for-hire basis, with group- or institution-owned vehicles that have a seating capacity of 10 or more persons and encourage the States to disseminate material to these groups on vehicle maintenance. (Class II, Priority Action) (H-79-10)

"Request that each State identify individuals or groups that transport persons on a not-for-hire basis, with vehicles that seat 10 or more persons and disseminate information about the National Highway Traffic Safety Administration's Schoolbus Driver Instructional Program and the National Safety Council's Defensive Driving Course to these individuals and groups. (Class II, Priority Action) (H-79-11)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ ELWOOD T. DRIVER
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

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