PB83-916203

Highway Accident Report - Jonesboro School District Schoolbus Run-off-Road and Overturn, State Highway 214 at State Highway 18 Near Newport, Arkansas, March 25, 1983

(U.S.) National Transportation Safety Board
Washington, DC

20 Sep 83

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB/HAR-83/03	2. Government Accession No. PB83-916203	3. Recipient's Catalog No.
4. Title and Subtitle Highway Accident Report—Jonesboro School District Schoolbus Run-Off-Road and Overturn, State Highway 214 at State Highway 18, near Newport, Arkansas, March 25, 1983		5. Report Date September 20, 1983 6. Performing Organization Code
7. Author(s)		8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594		10. Work Unit No. 3714A 11. Contract or Grant No. 13. Type of Report and Period Covered Highway Accident Report March 25, 1983
12. Sponsoring Agency Name and Address NATIONAL TRANSPORTATION SAFETY BOARD Washington, D. C. 20594		14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

About 5:40 a.m. on March 25, 1983, a Jonesboro School District schoolbus was traveling westbound on State Highway 214 near Newport, Arkansas. The schoolbus was transporting 31 high school students and 7 teachers from Jonesboro, Arkansas, to the Annual State Skills Olympics for vocational-technical students in Little Rock, Arkansas. As the schoolbus traveled through a relatively sharp right curve leading to a T-intersection with State Highway 18, it slid across the centerline onto the opposing lane's shoulder and through a stop sign; it continued to yaw and slide across Highway 18, where it overturned and struck the far edge of a roadside drainage ditch. The teacher-driver, 4 other teachers, and 4 students were killed, and 2 teachers and 27 students were injured.

The National Transportation Safety Board determines that the probable cause of this accident was the driver's failure to slow the schoolbus to a proper speed for negotiating a curve that led to a T-intersection with a stop sign and that had advance "curve" and "stop ahead" warning signs and an advisory speed sign. Contributing to the accident were the deficiencies of the intersection design and signing system, and the lack of reporting of a large number of low severity accidents and incidents at the curve that would have effectively alerted the Arkansas Highway and Transportation Department to deficiencies in the intersection design and signing system.

17. Key Words schoolbus accidents; schoolbus occupant protection; school activity trips; driver qualifications; inspection; maintenance; highway design; intersection design; traffic control devices; signing	18. Distribution Statement This document is available to the public through the National Technical Information Service Springfield, Virginia 22161		
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 39	22. Price

NTSB Form 1765.2 (Rev. 9/74)

CONTENTS

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

Adopted: September 20, 1983

JONESBORO SCHOOL DISTRICT SCHOOLBUS RUN-OFF-ROAD AND OVERTURN STATE HIGHWAY 214 AT STATE HIGHWAY 18 NEAR NEWPORT, ARKANSAS MARCH 25, 1983

SYNOPSIS

About 5:40 a.m. on March 25, 1983, a Jonesboro School District schoolbus was traveling westbound on State Highway 214 near Newport, Arkansas. The schoolbus was transporting 31 high school students and 7 teachers from Jonesboro, Arkansas, to the Annual State Skills Olympics for vocational-technical students in Little Rock, Arkansas. As the schoolbus traveled through a relatively sharp right curve leading to a T-intersection with State Highway 18, it slid across the centerline onto the opposing lane's shoulder and through a stop sign; it continued to yaw and slide across Highway 18, where it overturned and struck the far edge of a roadside drainage ditch. The teacher-driver, 4 other teachers, and 4 students were killed, and 2 teachers and 27 students were injured.

The National Transportation Safety Board determines that the probable cause of this accident was the driver's failure to slow the schoolbus to a proper speed for negotiating a curve that led to a T-intersection with a stop sign and that had advance "curve" and "stop ahead" warning signs and an advisory speed sign. Contributing to the accident were the deficiencies of the intersection design and signing system, and the lack of reporting of a large number of low severity accidents and incidents at the curve that would have effectively alerted the Arkansas Highway and Transportation Department to deficiencies in the intersection design and signing system.

INVESTIGATION

The Accident

About 5:40 a.m. on March 25, 1983, a Jonesboro School District schoolbus was traveling westbound on State Highway 214 near Newport, Arkansas. The schoolbus was transporting 31 high school students and 7 teachers from Jonesboro, Arkansas, to the Annual State Skills Olympics for vocational-technical students in Little Rock, Arkansas. The sky was clear, the road was dry, and the sun was just below the horizon. Civil twilight, which is considered to be the time of minimum sky illumination required to carry on normal work out-of-doors, had occurred at 5:34 a.m. Bus passengers reported that surface features were somewhat muted in the early morning daylight. The bus headlights were on high beam.

Passengers reported that the bus seemed to have been traveling at or near 55 mph for about 9 miles along a relatively straight section of open, rural highway. Most of the passengers were resting or sleeping, and they were not specifically directing their attention to the road ahead or to the actions of the driver. The passengers did not

remember seeing any opposing traffic or other potential distractions either inside or outside the bus. Passengers were not paying attention to and did not notice any road signs, and there was no apparent slowing of the bus as it approached and passed by: (1) a combination "curve" warning and advisory speed sign of "35 mph," (2) a "junction, State Highway 18" sign, and (3) a "stop ahead" sign. (See figures 1, 2, and 3.) These signs were posted at distances of 870 feet, 595 feet, and 250 feet, respectively, before the beginning of a relatively sharp, 210-foot-radius, 230-foot-long curve to the right that led to the T-intersection with State Highway 18 and a stop sign. (See figure 4.) In addition to the signs in advance of the curve, a solid yellow centerline for westbound traffic began near the "curve" warning and the "35 mph" advisory speed sign and extended through the curve. (See figure 1.) A 2-foot-high by 4-foot-wide sign depicting a large arrow pointing right was positioned on the opposing lane shoulder edge in the curve. This "large arrow" sign was directly in line with the centerline of Highway 214 east of the curve. (See figure 3.)

As the bus entered the curve, passengers yelled that the driver was "going too fast," and someone yelled for the driver to "slow down." One passenger heard the busdriver yell out "hang on, hang on" as he tried to maneuver the bus through the curve. No driver comments or actions relative to the brakes were seen or heard. The bus slid and rotated across the curve centerline and onto the shoulder of the opposing traffic lane; it continued to yaw and slide across Highway 18, where it overturned and struck the far edge of a roadside drainage ditch alongside Highway 18. (See figures 5, 6, and 7.) The engine stopped at impact, and a small fire developed in the bus engine compartment. No one was ejected from the bus.

Those passengers in the rear of the bus who were not seriously injured exited through the rear emergency door of the bus. The passenger who opened the door said that it opened easily. After exiting the bus, these passengers kicked in windows to gain access to more seriously injured passengers in the front half of the bus where the roof was partially collapsed. The passengers used dirt and water from the drainage ditch to extinguish the engine compartment fire. One passenger ran to a mobile home located about a half-mile from the accident scene, and the mobile home resident summoned police, emergency services, and neighbors, all of whom began to arrive at the scene shortly after 6 a.m. The teacher-driver, 4 other teachers, and 4 students were killed, and 2 teachers and 27 students were injured in the crash.

Injuries to Persons

Injuries	Drivers	Passengers	Total
Fatal	1	8	9
Nonfatal	0	29	29
None	0	0	0
Total	1	37	38

Driver Information

The 44-year-old busdriver was a building trades teacher at the Vocational-Technical Training Center in Jonesboro. He had a valid Arkansas driver's license with no operating restrictions. No accidents or traffic violations were listed on his driving record. He lived in the Jonesboro area all his life, and he had driven a schoolbus as a part-time job after graduating from high school and while attending Arkansas State College in Jonesboro. As a teacher, he routinely drove schoolbuses to take his classes to job sites and occasionally to drive for activity groups on class trips. On two trips that were made about 1 month and 5 months earlier, he had driven a schoolbus along the same route that was being taken on the day of this accident.

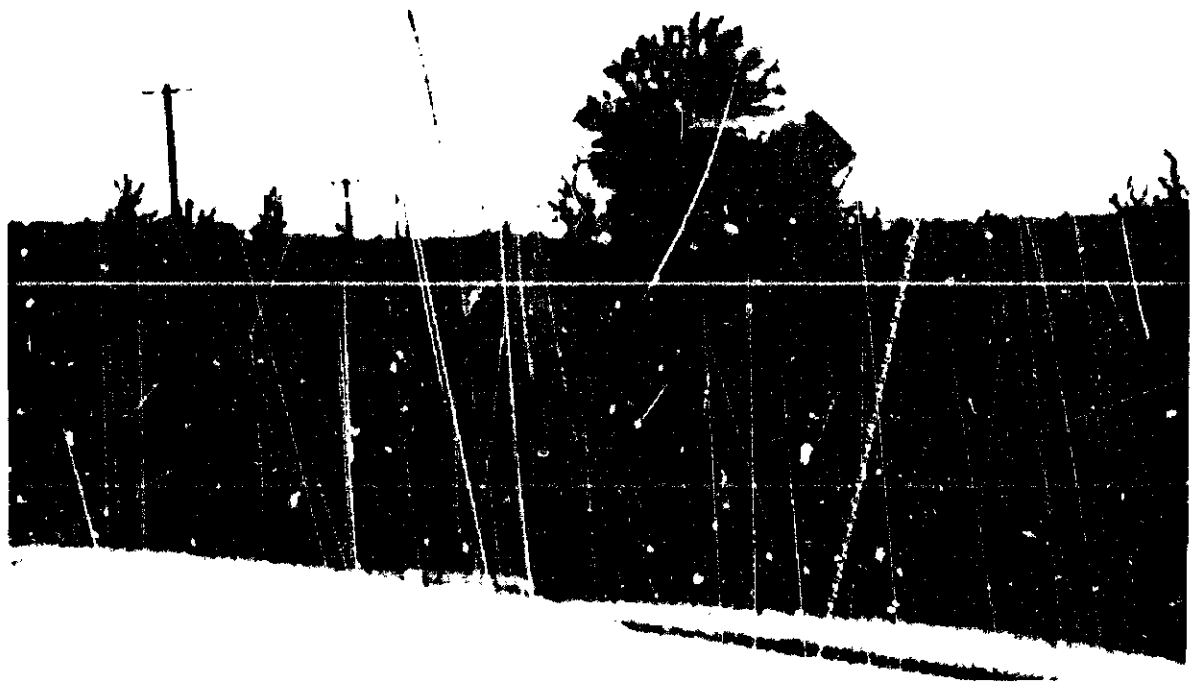


Figure 1.--"Curve" warning and "35 mph" advisory speed sign that was located about 870 feet before the beginning of the accident curve. Note the beginning of the solid centerline.

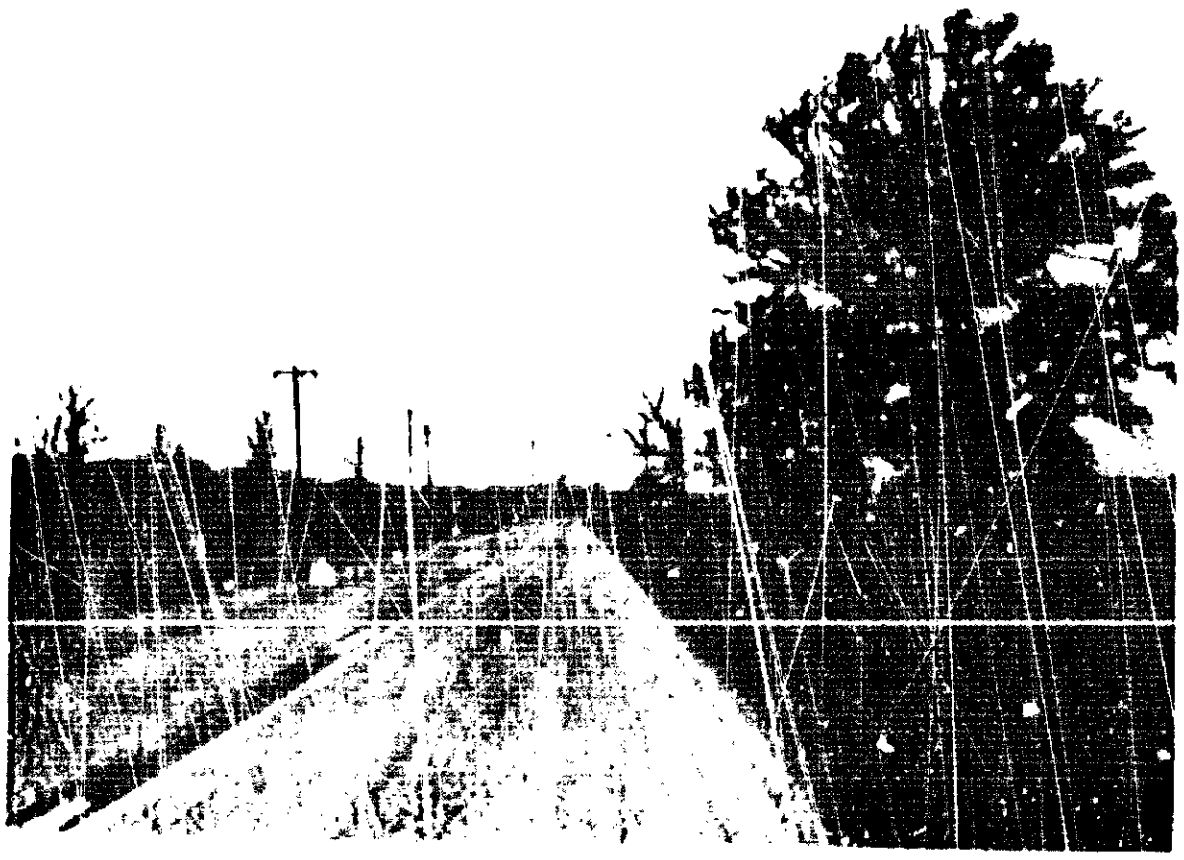


Figure 2.--"Junction, State Highway 18" sign that was located about 595 feet before the beginning of the accident curve.

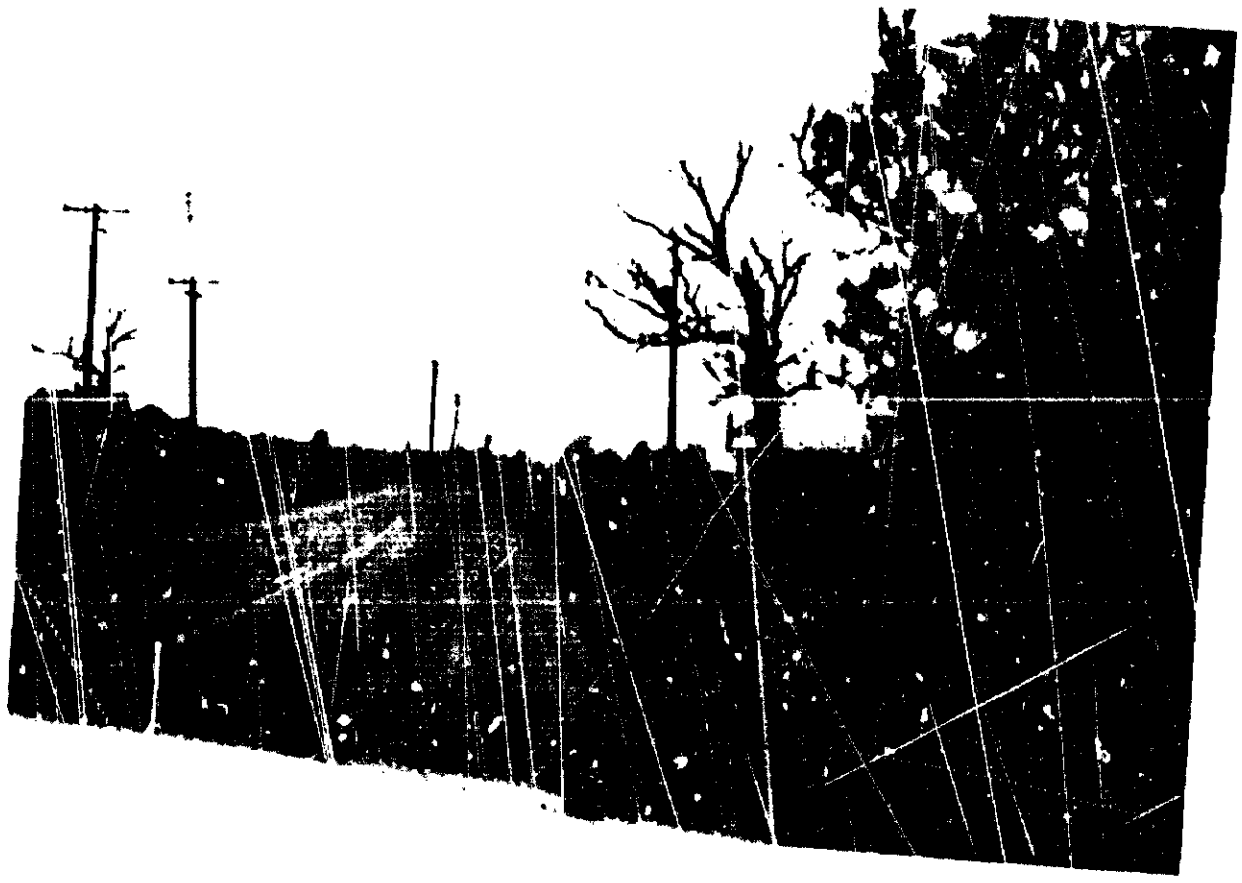


Figure 3.--"Stop Ahead" sign that was located about 250 feet before the beginning of the accident curve, and the "large arrow" sign that was posted in the curve. Note the alignment of the telephone poles and the field to the left and in the background.

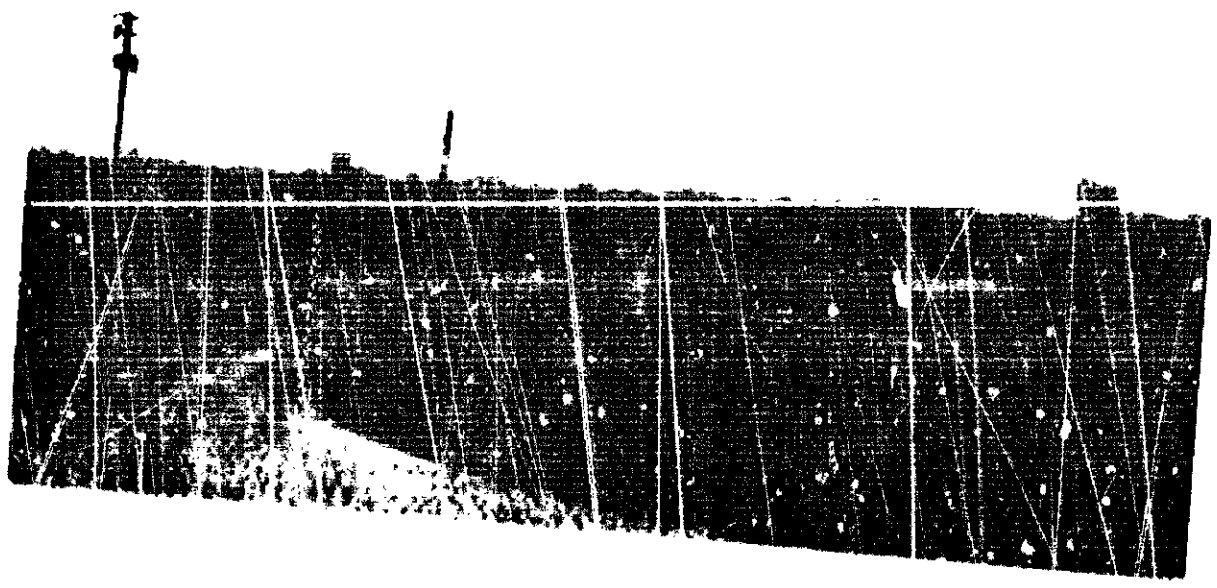


Figure 4.--Intersection of State Highway 214 and State Highway 18 at the end of the accident curve.

Figure 5.--Aerial view of the T-intersection of State Highway 214 with State Highway 18. "A" denotes the approximate final position of the schoolbus; "B" points between the tire marks of the schoolbus as it slid out and across State Highway 18; "C" indicates the point where the schoolbus crossed the centerline; and the "D's" indicate the old highway alignments at the intersection.

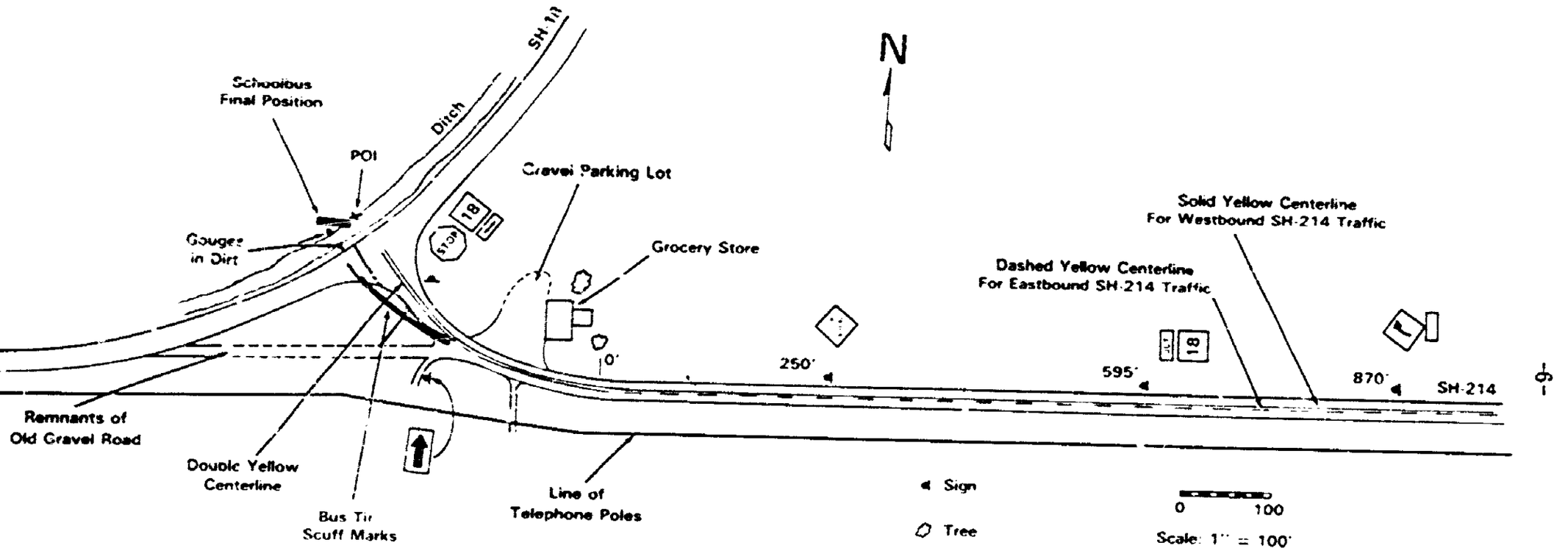


Figure 6.--Plan view of accident site.

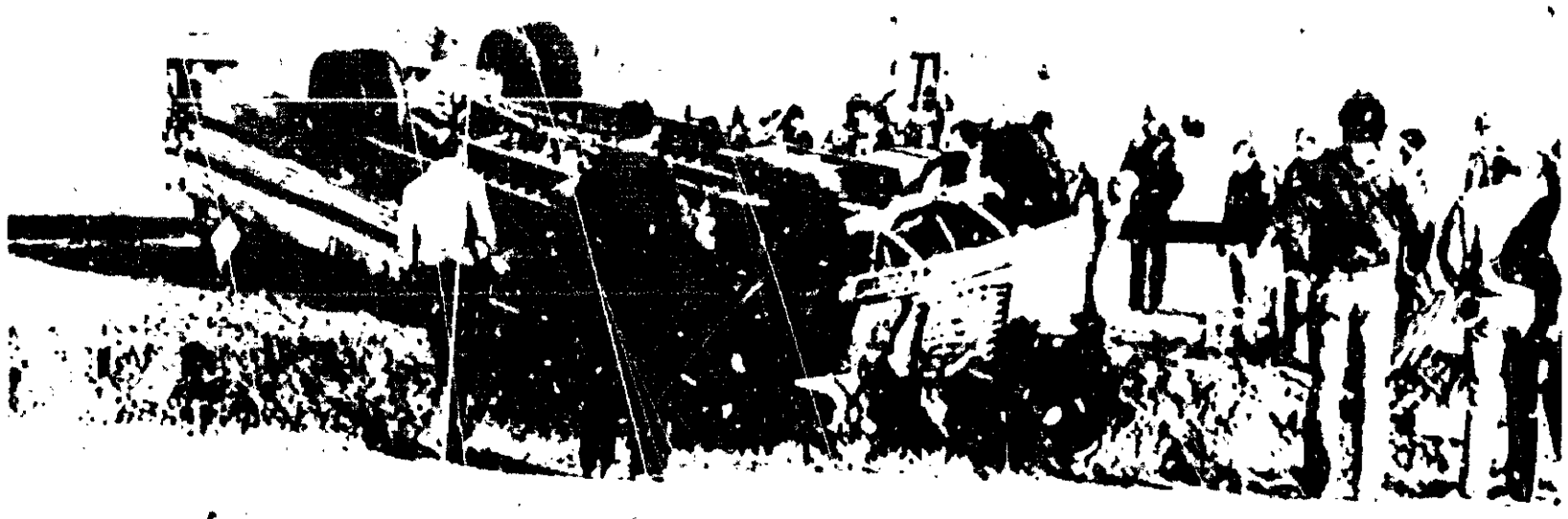


Figure 7.--Final position of the schoolbus. Note that the roof was collapsed to the bottom of the window at the left front of the bus.

The driver had a schoolbus driver's certificate that is required by Arkansas State law to operate a schoolbus. The certificate was issued on December 12, 1982, by the Arkansas State Police on the basis of a driver's test. There is no record that the driver received any formal schoolbus driver training. Although the Jonesboro School District requires driver training for its regular operators, this driver was a "teacher-driver" who operated schoolbuses only on field trips and other extracurricular activities.

The driver had been dieting during the month before the accident, and he had lost about 6 to 8 pounds in body weight. He was 6 feet tall and weighed about 200 pounds. His daily activities were not unusual during the week before the accident, and he had no history of medical problems.

The driver had assisted in inspecting and repairing the bus in the early evening on the night before the accident, and he had left for home between 6:30 p.m. and 7 p.m. He went to bed about 9:30 p.m. and woke up about 4 a.m., getting about 6 1/2 hours of rest/sleep. He normally got about 8 hours of rest/sleep per night. Survivors did not notice anything unusual about his appearance, demeanor, or conduct before they left on the trip, and everyone interviewed by the Safety Board seemed to have a high opinion of his skill as a busdriver. The bus left the school about 5 to 10 minutes later than planned, but there was no scheduled arrival time in Little Rock.

Vehicle Information

The schoolbus was owned by the Jonesboro School District. It had a 1975 International Harvester Corporation chassis and a 1977 Ward body. A label placed on the bus by Ward in compliance with Federal regulations stated that the manufacturing date was the 1975 date of manufacture of the incomplete vehicle (the date of manufacture of the chassis). It was equipped with an 8-cylinder gasoline engine, a 5-speed manual-shift transmission, a mechanical fuel pump, power brakes, and power steering. The bus had a 72-passenger seating capacity if passengers sat three to a seat, or a 48-passenger seating capacity if passengers sat two to a seat. Passengers on this trip sat a maximum of two to a seat. The passenger seats did not have seatbelts; the driver's position was equipped with a seatbelt.

In Arkansas, schoolbuses are required to be inspected once each year. The authority of the Arkansas State Police to perform the inspections has been delegated to authorized inspection stations. School districts in Arkansas, including the Jonesboro School District, generally operate their own authorized inspection stations to inspect their schoolbuses. This practice of self-inspection is not uncommon and is done in other States and by vehicle owners and operators who use a fleet of vehicles to conduct their business. The State Police train and periodically check the schoolbus inspectors.

Records indicate that the schoolbus involved in the accident underwent a State inspection on August 7, 1980, at 20,750 miles; on August 31, 1981, at 25,980 miles; and on August 31, 1982, at 30,710 miles. The 1980 inspection reported that repairs to the glass, wheels, alignment, and seats were necessary. The 1981 report indicated that repairs to glass, service brakes, and seats were required. The 1982 inspection reported that repairs to the steering system, service brakes, parking brake, signal lamps, tires, wheels, alignment, and seats were required.

In addition to the State inspection, schoolbuses are inspected annually by the school district as required by the Arkansas Department of Education. The inspection forms for 1980 through 1982 indicate that no discrepancies were found for the schoolbus involved in the accident.

The Jonesboro School District owns 17 schoolbuses, is planning to purchase 4 new schoolbuses, operates its own maintenance facility, and employs one full-time mechanic. The mechanic was hired from the school maintenance crew, which is in charge of general repairs such as carpentry and plumbing, and had been working in his present position for about 3 years. Before working for the school district, the mechanic had operated a garage, which was the source of his vehicle maintenance experience and the reason he was selected as the schoolbus mechanic. No specific qualifications for the mechanic's position were identified or announced by the Jonesboro School District. The mechanic attended the 1982 and 1983 annual 4-day workshop for schoolbus mechanics sponsored by the Arkansas Department of Education. The workshops are taught by experienced instructors and cover such topics as the service and maintenance of tires, brakes, steering systems, engines, and drive-line systems or components.

Before the accident, a helper for the mechanic was acquired when needed from the school maintenance crew. Following this accident, a full-time helper was hired from the school maintenance crew on the basis of mechanical aptitude. No specific qualifications were identified or announced for the helper's position. The State requires one mechanic and one helper per 20 buses.

The one-bay maintenance facility that was in use at the time of the accident no longer exists. It will be replaced by a large two-bay facility under construction near the Jonesboro High School.

The maintenance program established for each schoolbus operated by the Jonesboro School District includes servicing three times a year, scheduled maintenance once a year, and unscheduled maintenance as needed. The following repair operations were reported on Jonesboro School District maintenance records for the accident bus:

Date	Operation
02/15/83	Checked brakes and added fluid
12/15/82	Tighten, weld exhaust system
11/12/82	Replace distributor to coil wire, points and condenser
09/29/82	Repair flasher system
09/28/82	Tighten worn gear steering sector
09/17/82	Check toe-in
09/15/82	Replace inside rear wheel seal
08/25/82	Repair power steering
08/17/82	Change two rear duals, adjust clutch
07/19/82	Replace front wheel brakes
07/08/82	Turn drums, adjust brakes
04/18/82	Tighten exhaust and adjust emergency brakes
03/17/82	Replace right rear grease seal
02/23/82	Replace speedometer
02/22/82	Replace rear wheel seal.

Except for a few minor light bulb failures, no vehicle problems were reported in 90 driver trip reports for the accident bus between August 18, 1982, and March 24, 1983.

The bus was used regularly to transport children to and from school, including the day before the accident. The regular, daily driver told Safety Board investigators that the bus brakes had felt "mushy" about a month before the accident, that the school's maintenance facility apparently had corrected the problem, and that he had not experienced any mechanical problems with the bus during the past month. The brake problem was not reported in a driver trip report. He could not comment on the bus' performance at higher, open-road speeds, because school rules did not permit any bus used for transporting students to and from school to be operated at speeds greater than 35 mph.

The bus was the third bus that had been assigned to the Skills Olympics group for the trip to Little Rock. An "activity bus," which had space for storing luggage underneath the passenger compartment, had been assigned originally. Two weeks before the trip, however, that bus was assigned to the track team, and a smaller bus was assigned to the Skills Olympics group. However, because the number of seats in the smaller bus would have required some passengers to sit three to a seat, the group asked for and was assigned the larger bus involved in the accident.

The bus was assigned to the teacher-driver after it completed its regular route on the day before the accident. The driver, a teacher-passenger who taught automotive repair, and a student-passenger inspected and repaired a number of items on the bus. The

student-passenger survived the crash. He reported that they had brazed (a soldering technique) a leaking exhaust system pipe joint that was located under the extreme forward portion of the passenger compartment. The brake master cylinder reservoir was noticeably low in brake fluid and was refilled. The rear-axle differential housing lubricant was low and was refilled. The student-passenger said that he had looked at the inside surface of each wheel of the bus and saw no evidence of leaking fluid. Mountings for both front shock absorbers and the steering column assembly were tightened. Three sparkplug wires were replaced, the carburetor air cleaner was cleaned, and the engine was tuned. Although the bus was not road-tested that evening, the busdriver did apply the brakes hard in the school parking lot to "test them" before starting the trip, and passengers were forced forward in their seats during that brake application. One passenger reported that she felt a "shimmy" in the right front wheel during the trip and that she heard the busdriver comment that the bus was "a sorry bus."

In a postaccident inspection of the bus, only the right front wheel brake was found to be adjusted properly. Each wheel brake had selfadjusting mechenisms. The lower left front brake shoe had not been installed properly and had been making only limited contact with the brake drum. All wheel brake cylinders had been leaking brake fluid, and the brake linings were partially saturated. However, there was no detectable evidence of brake fluid leakage on the external surfaces of the brake, wheel, and tire assemblies. The brake system discrepancies were discovered after the tires, wheels, and brake drum assemblies were removed during the postaccident inspection. The right rear wheel bearings were loose, and rear-axle differential housing lubricant was leaking past the bearing seal and had soaked the right rear brake blocks. (Brake blocks are equivalent in function to brake linings.)

The bus' front wheel king pin bushings and the ball joint connection between the drag link and steering lever were loose. The right front tire was out of balance. These conditions would have produced free play in the steering system and wheel shimmy.

The exhaust system joint that was brazed before the trip separated during impact. The transmission was found in fifth gear after the accident. The reading on the odometer was 34,150 miles at the time of the accident. However, the speedometer and odometer were replaced on February 23, 1982.

The left corner of the bus roof and the top of the left fender and hood were heavily deformed. The left front roof section had collapsed and had cut or deformed the tops of the passenger seatbacks of the first four rows of seats on the left side of the bus. (See figure 7.) The right side of the roof was not as severely collapsed as the left. The rear two-thirds of the roof had not been deformed significantly. Ten of the 24 seatbacks were deformed forward without significant seatframe deformations. (See appendix B.) All aisle-side, seat-leg-to-floor attachments maintained their integrity. At seat rows 7 and 8 on the right side of the bus, the welds that held the seatframes to brackets that were bolted on the sidewall of the bus failed, and these seats were loose at the sidewall of the bus. At seat rows 7 and 11 on the left side, some of the bolts were missing from the sidewall brackets; however, the seats remained attached to the wall. All passenger seats remained in place and, other than roof collapse at the front third of the bus and some seatback deformations, there was no significant invasion of passenger seating space.

Fire damage was confined to the top and left side of the engine. The side window posts at the first four rows of passenger seats on the right side of the bus had been cut out for posterash rescue and evacuation of trapped and/or seriously injured occupants in the front area of the bus.

Highway Information

State Highway 214 is an east-west, two-lane, asphalt, chip-seal highway through rural, open farmland in northeast Arkansas. The highway is relatively straight for about 9 miles before the sharp right curve at the accident site, with only occasional curves that can be maneuvered easily while traveling at or near the unposted speed limit of 55 mph. The approach to the intersection with State Highway 18 is uphill at approximately an 0.8 percent grade. The highway had been resurfaced with a chip seal about a year before the accident, and it had no surface bumps or other abnormalities.

The pavement markings about 885 feet before the curve at the accident site consist of a solid yellow line for westbound traffic and a dashed yellow line for eastbound traffic. The dashed line is replaced by a solid yellow line about 189 feet from State Highway 18. The markings were painted in the summer of 1982 and were in good condition.

The accident curve on State Highway 214 has a 210-foot radius and a superelevation of 0.09 foot per foot. The Arkansas Highway and Transportation Department (AHTD) determined the posted advisory speed of 35 mph by the use of a ball bank indicator. The ball bank reading is a measure of the amount of lateral force on a vehicle while driving around a curve. According to AHTD policy, the posted speed is the nearest 5-mph incremental speed that registers 15 degrees or less on the indicator.

The physical evidence of the accident included three tire marks on the pavement and shoulder in the curve and across State Highway 18, and two gouge marks and two tire depressions in the ditchbank on the west side of State Highway 18. (See figure 6.) The tire marks had striations which were oblique to the tire mark.

Prior to 1977, State Highway 214 was a gravel road that had no curve at the accident site, and State Highway 18 was a paved highway that had its current type of curvature near the accident site. State Highway 214 intersected with State Highway 18 at a sharp acute angle west of the accident site. Another gravel road intersected State Highway 214 at a right angle at its south end and then connected with State Highway 18 at a sharp acute angle at its north end. (See figure 5 for indicators of the old highway alignments that are still visible at the accident site.) Under these conditions, State Highway 18 was the major, through route and State Highway 214 was a minor, connecting route.

According to traffic studies conducted by the AHTD in the mid-1970's, projections were that State Highway 18 would continue to carry the majority of traffic to and through the intersection near the accident site. In 1976, an average of 800 vehicles per day traveled on State Highway 18 near the Poinsett/Jackson County line about one-half mile west of the intersection with State Highway 214. No other traffic volume numbers were available for State Highway 18 in 1976, and no projections for future traffic on this road were made at that time. In 1976, an average of 230 vehicles per day traveled on State Highway 214 when it was a gravel road. The traffic volume on this road was projected to increase to an average of 430 vehicles per day in 1990. These are low traffic volumes for two-lane, two-way roadways.

When State Highway 214 was upgraded and paved in 1977, the intersection was redesigned so that State Highway 18 would remain the major, through route, while State Highway 214 would remain a minor route leading to a T-intersection with State Highway 18. State Highway 214 was curved to intersect at a right angle with the center of the State Highway 18 curve to eliminate the old, sharp-angled intersection and to maximize the sight distance for drivers entering State Highway 18. According to the AHTD, other highway intersections in Arkansas have been constructed, signed, and marked in a similar manner.

In August 1982, the traffic volume on State Highway 18 west of the intersection with State Highway 214 averaged 995 vehicles per day. The traffic volumes on State Highway 18 north of the intersection and on State Highway 214 east of the intersection averaged 416 and 595 vehicles per day, respectively.

Prior to this schoolbus accident, the AHTD had received only two police reports of property-damage-only accidents occurring at the accident curve. 1/ One accident involved a pickup truck that ran off the road in the curve and rolled over; the pickup truck driver reported that she could not see well because of an early morning fog. The second accident involved a car that traveled the same path as the schoolbus, but did not roll over. The car driver reported that he did not see the curve until it was too late because he was involved in flashing his lights at an oncoming vehicle with its high beams on. The car driver said that the oncoming vehicle actually was operating eastbound on State Highway 18. This illusion of an oncoming vehicle on State Highway 214 can occur because of the manner in which both highways are oriented along the same line and direction before they both curve to the north and intersect. (See figure 5.)

On March 29, 1983, the AHTD held a public hearing at the request of local residents. Twenty-five of the 100 attendees reported that they personally had assisted people involved in other accidents at the curve. Safety Board investigators interviewed the current and previous owners of a grocery store located at the curve, an employee at that store, and residents of a house near the curve. Collectively, the two store owners said that about 200 property-damage-only/loss-of-control/emergency maneuver accidents or incidents had occurred at the curve over the past 6 years. In addition, two to three times a day, persons at the store would hear tires squealing from vehicles that apparently were making emergency maneuvers around the curve or sliding to a stop at the stop sign. The Safety Board found relatively fresh tire marks from two previous incidents during its 5-day, onscene investigation of the schoolbus accident, indicating that such incidents were occurring.

Local residents reported that most of the accidents or incidents occurred at night and on weekends. There appeared to be fewer incidents during inclement weather, perhaps because of lower traffic volumes or operating speeds, according to residents. Cars and pickup trucks were usually involved, but one store owner said that he towed at least three tractor-semitrailers out of the ditch at the curve. Most of the accidents or incidents were said to have involved persons who were not familiar with the site, but five area residents said that they had had an accident or incident at the curve. Several of the accidents were said to have involved young drivers, drivers who had been traveling above the speed limit, or drivers who had been drinking alcohol. Residents also reported that reflectorized delineators had been placed around the outside of the curve on State Highway 214 when it was constructed, but that they had been knocked down soon after installation and had not been replaced.

Meteorological Information

At the time of the accident, it was about 15 to 20 minutes before sunrise, the road was dry, and the sky was clear. The Jonesboro Airport 0600 Sequence Report showed the visibility at 7 miles, temperature 30° F, dew point 27° F, and wind 030° at 5 knots. Sunrise at the airport occurred at 0558. The airport is approximately 27 miles northeast of the accident site.

1/ A total of seven accidents were reported near the intersection of State Highways 214 and 18 over a 6-year period. They included four accidents on the curved section of State Highway 18, the schoolbus accident described herein, and the two accidents described above.

Medical and Pathological Information

The driver was not wearing the seatbelt that was available for the driver position only; he was found trapped in his seat between the collapsed roof and the steering wheel after the accident. An autopsy attributed his death to "multiple blunt trauma to the head and chest." Blunt trauma refers to direct impact between a human body and bus components--not crushing-type injuries that could occur if a body was crushed between two bus components, such as the top of the seatbacks and the collapsed roof. No evidence of alcohol, drugs, or medical problems was detected. There was no evidence of carbon monoxide in the driver's blood.

No autopsies were performed on the eight passenger fatalities. Data from external tests and observations by the county coroner and morticians indicated that all of the passenger fatalities were the result of head injuries or head and neck injuries. These fatal injuries were attributed to "blunt trauma." One of the fatally injured adult male passengers was trapped across the chest between the roof and the top of the first seatback on the left.

Twenty-nine passengers were injured. Of the nine passengers who had serious, severe, or critical injuries, four suffered head injuries and three incurred ruptured spleens. Four of the five persons with moderate injuries suffered fractures of the spine. Fifteen passengers had minor injuries consisting of abrasions, contusions, and lacerations to various parts of the body.

Survival Aspects

The eight passenger fatalities were seated in the first four rows at the front of the bus. (See figure 8.) Seven of the nine passengers who had serious, severe, or critical injuries were located within the first four rows of the bus. Nineteen of the 20 passengers who had only moderate or minor injuries were located behind the fourth row of the bus. Appendix C describes the passenger injuries by severity and seating location.

A fire extinguisher was located in the front of the bus near the driver, but that area of the bus was collapsed and blocked by injured passengers and was relatively inaccessible. Students who looked for the fire extinguisher did not know where it was located.

Tests and Research

The Safety Board conducted visibility tests at the accident site on March 27, 1983, using a similar schoolbus and spanning the time of day before, during, and after the time that the schoolbus accident occurred. A combination house and grocery store located at the beginning of the curve was closer to the highway than other buildings along the 9-mile section of highway. (See figure 3.) This store and the highway signs were the only noticeable landmarks near the accident curve. There were no advertising signs to distinguish the store from other houses or farm buildings.

With no opposing traffic and with the test vehicle's high-beam headlights on, Safety Board investigators could perceive the traffic control signs in advance of the curve from a distance of 2,200 feet from the curve during darkness, and from an even greater distance during daylight. Sign messages could be read day or night at a distance of about 250 feet from each sign; the distance that sign messages could be read was predicated on the size of the letters used in the sign, not illumination levels. With no opposing traffic, during darkness, and with the test vehicle's low-beam headlights on, the "large arrow" sign could

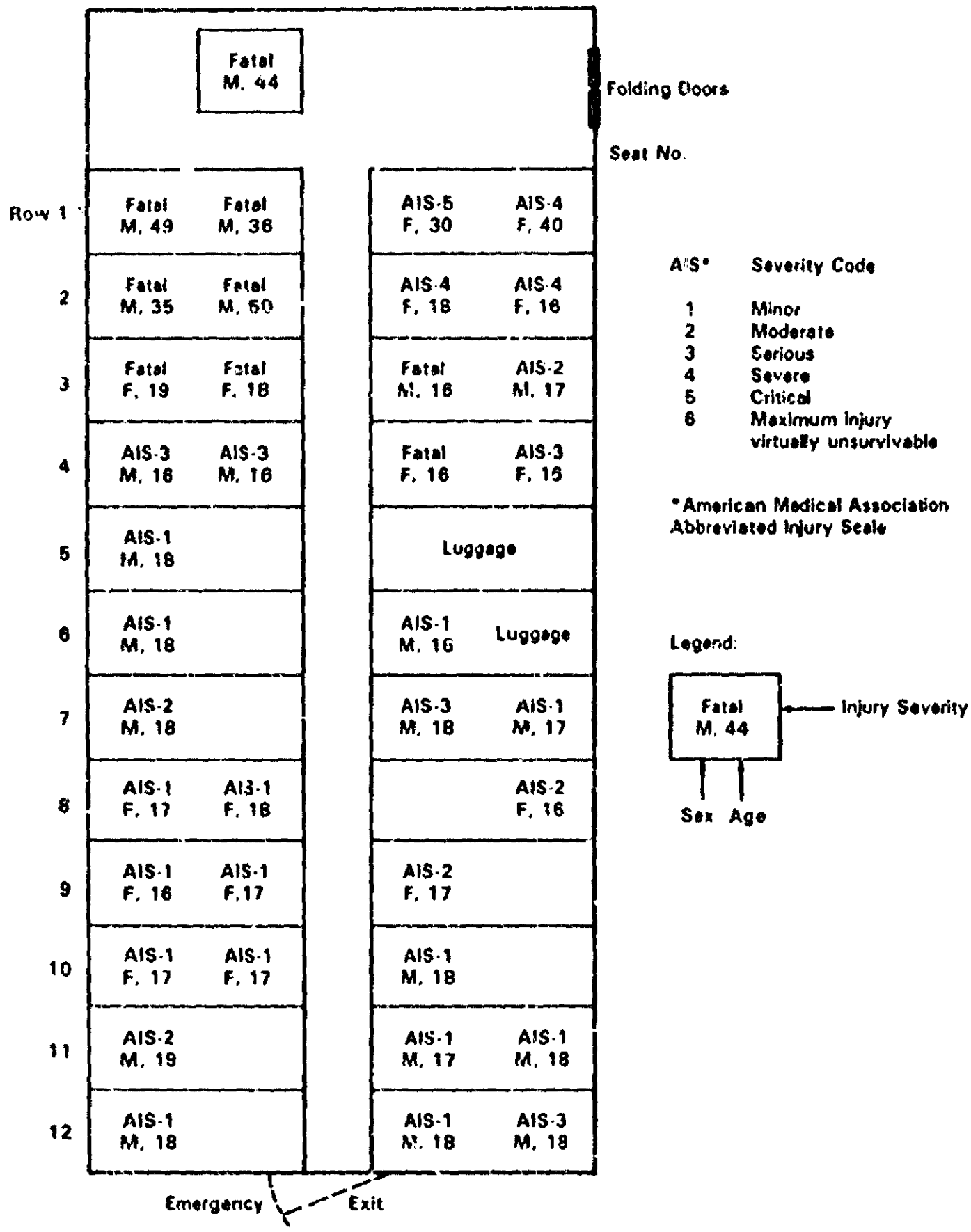


Figure 8.-- Schoolbus seating chart noting occupant age, sex, injury severity, and seat location.

be seen at a distance of about 500 feet before entering the curve. Day or night, with no opposing traffic, the centerline and pavement could be seen curving and bearing to the right at about 275 feet before entering the curve. The stop sign was not fully visible until the test vehicle was in the curve and about 200 feet from the stop sign.

As revealed in the second of the two previously reported accidents at the curve, when vehicles are operating with their lights on, the headlights of eastbound, and taillights of westbound, vehicles on State Highway 18 create an optical illusion to westbound vehicles on State Highway 214. The headlights from eastbound vehicles on State Highway 18 "wash out" the visibility of the centerline, the pavement in the curve, and the "large arrow" sign posted in the curve, and make it appear that State Highway 214 is straight or slightly curved rather than curved sharply to the right. The taillights of westbound vehicles on State Highway 18 also make the road ahead appear to be continuous and straight. In the daytime, an illusion of a straighter road is created by the alignment of telephone poles along the eastbound side of State Highway 214 which continue straight across the open field in an east-west direction between the two highways. Also, another field in the distance and beyond the curve appears to be a guardrail or an intersecting road farther ahead because of its narrow width and color. (See figure 3.)

During visibility tests made at approach speeds of 45 to 55 mph, Safety Board investigators and other invited observers depended on a variety of visual cues to drive through the accident curve. The only sign that was consistently sighted and used was the first symbolic "curve" warning sign; the second most-sighted sign was the "large arrow" sign. Conspicuous by the lack of consistent use as cues were the "35 mph" advisory speed sign, the "junction" sign, and the "stop ahead" sign.

The AHTD ran a skid test on State Highway 214 near the accident curve with a calibrated skid trailer a few weeks after the accident. The results of the tests run on wet pavement at 40 mph indicated an average skid number of 45.5 for the test vehicle. Based on this value and observation of the road, the estimated coefficient of friction in longitudinal direction for passenger cars on a dry surface is 0.8. A typical coefficient of friction for a good dry road surface ranges from 0.7 to 0.9. If this number is adjusted for bus tires and a lateral direction the estimated coefficient of friction in the lateral direction for buses on a dry surface ranges from 0.48 to 0.56.

Speed calculations were made to determine the critical speed of the curve 2/ and the speed of the bus as it entered the curve. The side-scuffing character of the tire marks left by the bus as it slid across the centerline indicated that the driver had waited until he was already into the curve before beginning a right steering action and that he was only steering, and not braking, the bus at this point. Because of this late turning maneuver, the bus was turning in a radius smaller than that of the curve--a radius of 174 feet compared to the 210-foot radius of the curve. Using a superelevation of 0.09 foot per foot, a radius of 174 feet, and an estimated coefficient of friction ranging from 0.48 to 0.56, the critical speed of the curve was calculated to be between 38.5 mph and 41.2 mph. The speed at which the bus negotiated this 174-foot curve would have been greater than the critical speed of the curve.

2/ "The Traffic Accident Investigation Manual," J. Standard Baker, Traffic Institute, Northwestern University, page 315 defines critical speed as "a velocity above which a particular highway curve could not be negotiated by a motor vehicle without yaw."

Schoolbus Driver Training

Pre-service Training.--Arkansas State law requires that, after the 1963-64 school year:

> No school bus driver shall be employed to act as chauffeur or operator of any school bus to transport children to and from school, or school-sponsored activities, unless he has satisfactorily passed the tests required herein and possesses a valid certificate therefor.

The tests include:

> An eye test, a written or oral test on rules and regulations of driving, a road test given under the supervision of the Arkansas State Police, and such other requirements as may be prescribed by rules and regulations issued jointly by the Arkansas State Police and State Department of Education for qualifications and fitness of school bus drivers.

The law also states that "extra-curricular trips shall be made by certified operators only."

Arkansas State law also requires the following:

> All 17 year old drivers must have had at least two (2) years experience as a regular licensed driver of a motor vehicle, must attend such school bus driver training course as the State Board of Education may require, pass satisfactorily a physical examination given by a licensed physician for school bus drivers, satisfactorily pass a test on traffic laws and safety regulations for the operation of school buses and a road test for bus drivers given under supervision of the State Highway Patrol or the State Department of Education.

State Board of Education Regulations issued in December 1972 state that "each beginning driver should be given a complete course in training before he is employed as a driver" and outlined a "suggested" curriculum totaling a maximum of 13 hours of training, including 2 to 4 hours of behind-the-wheel instruction.

An "Administrator's Handbook for School Transportation" prepared by the Arkansas Department of Education (probably in 1974) indicates that "new school bus drivers, i.e., drivers who have not previously driven school buses with student passengers" should receive preservice training consisting of both classroom instruction and practice driving instruction. Drivers "with previous experience" should be considered separately; the "type and extent of the training [such an applicant] will be required to complete" should be based on the "quality and recency" of the applicant's prior experience.

A memorandum from the Arkansas Department of Education to school superintendents and county school supervisors, dated July 22, 1983, states that "state law, state board of education regulations, or federal regulations" require that local school administrators "provide each driver with pre-service and behind-the-wheel instruction."

In-service Training.--Arkansas State law does not require in-service training. The "Administrator's Handbook for School Transportation" also does not refer to in-service training. The 1972 State Board of Education Regulations state that "experienced drivers should have a refresher course at least once a year," but do not describe its suggested

length or content. The Arkansas Department of Education memorandum of July 22, 1983, states that "state law, state board of education regulations, or federal regulations" require that school officials "require all drivers to attend in-service workshops and other school bus safety meetings as needed."

Discussions with the director of in-service schoolbus driver training for Greene, Clay, and Craighead Counties (which includes the Jonesboro School District) indicate that such in-service training is not handled by local school officials, that it is typically about 2 days of training (at separate times during the school year), and that it may include behind-the-wheel instruction for new busdrivers. All drivers are required to take this in-service training each year. Until this year, each class attended by Jonesboro School District personnel included about 75 to 100 busdrivers; about 120 busdrivers attended the training on August 12, 1983. Since there are only about 60 instructors statewide for in-service training, the training director said that there is not enough manpower to provide new drivers w h the degree of in-service, behind-the-wheel instruction they may need.

ANALYSIS

The Accident

The teacher-driver of the schoolbus was a healthy, experienced driver who had no previous record of poor driving. The 6- to 8-pound weight loss he experienced over a -month period of dieting is a safe rate of loss, and it should not have affected significantly his health or ability to drive safely. He had taken appropriate measures to be as rested as his time and the trip schedule would permit. There was no evidence that he suffered a sudden medical problem on the approach to the curve or that he was impaired by fatigue, exhaust fumes, or other similar factor.

The schoolbus was in poor mechanical condition when it was assigned to the activity trip on the afternoon before the accident. The effort made by those involved in the activity trip to inspect and repair the bus was unique and should be commended. It is doubtful that the teacher-driver, the auto mechanics instructor, and the student who attempted to correct problems detected in the steering, brakes, exhaust system, and rear axle knew the true nature of the vehicle's condition. Many of the repairs were at best "band-aid" repairs to major mechanical discrepancies discovered during the posterash inspection. The mechanical condition of the bus was bad enough for the teacher-driver to refer to the bus as "a sorry bus" during the trip. However, the Safety Board found no evidence to suggest that the mechanical condition of the schoolbus contributed to the accident.

There was also no evidence to suggest that the driver was distracted by activity inside the bus or by other vehicular traffic. Because no traffic was reported on either highway at the time, the illusional and "wash out" effects from opposing State Highway 18 traffic probably were not present. However, for an unknown reason the driver entered the curve at too high a speed. The survivors estimated that the bus had been traveling at or near the 55-mph speed limit for several miles before the curve and that they did not detect any noticeable deceleration of the bus before it entered the curve. However, most passengers were resting or sleeping and they may not have detected a light brake application or the situation where the driver may have coasted in gear to reduce speed. The bus was traveling at a calculated speed of at least 39 to 42 mph when it exceeded the critical speed of the curve and slid toward the outside. At this point, it was out of control. The speed of the bus when it began to slide, the late turning maneuver to the right outlined by the tire marks, and the lack of any evidence of braking indicated that the driver did not expect the sharp right curve and that he did not see or did not respond

to the "35 mph" advisory speed plate, the junction sign, and the "stop ahead" sign. He probably reacted to the "large arrow" sign, but he was already in the curve and did not have sufficient time to slow his vehicle before it began to slide. Although the brakes were in poor condition, the right front brake probably would have left a tire brake mark on the pavement if the brakes had been applied hard before the bus began to slide.

The Safety Board's visibility tests conducted with a similar bus under the same lighting conditions at the time of the accident illustrated that the advance traffic control signs provided adequate warning of the sharp right curve to an alert driver. Time and distance calculations indicated that the driver of a bus with brakes in good working condition could slow the bus safely from 55 mph to between 30 and 35 mph if he reacted either to the combination "curve" warning sign and "35 mph" advisory speed sign or to the "stop ahead" sign and the "large arrow" sign which could be read 500 feet before the curve. 3/ The curve could be negotiated and the bus stopped at the intersection without difficulty if braking continued from the 30- to 35-mph speed. If the driver reacted only to the "large arrow" sign, the curving pavement, and the curving centerline when they were visible and prominent 275 feet from the curve, a hard braking force would be required to slow the bus from 55 mph to between 30 and 35 mph upon entering the curve. The Safety Board concludes that drivers would experience problems controlling their vehicles at the accident site if they ignored the basic intent of the signs on the approach to the curve or were operating over the speed limit.

Because of the numerous accidents/incidents at this curve reported at the public hearing, the Safety Board believes that the busdriver's lack of response to the traffic control signs was not an uncommon driver reaction. Either the signing is not totally effective for a less than alert driver or the presence of other visual cues can mislead a driver. Such other visual cues include the illusion of a straight road created by the alignment of the telephone poles along the old abandoned road section beyond the beginning of the curve of State Highway 214, the presence of the store which visually obstructs the T-intersection with State Highway 18, and the fact that State Highway 214 is essentially straight for 9 miles preceding the sharp 210-foot-radius right curve. The low accident rate of two reported accidents in 6 years would not have indicated to the AHTD any need for a detailed analysis of the accident reports or the accident location. It was only after this schoolbus accident focused attention on the curve that several local residents reported an extensive accident history at this location.

The Intersection

The Safety Board believes that the design of the curve and intersection was deficient and was the foundation for the traffic control problems that evolved. The policy manual published by the American Association of State Highway and Transportation Officials (AASHTO) for the design of rural highways 4/ is recognized as a national standard and generally advocates the type of intersection realignment that was used by the AHTD. By replacing sharp or acute-angle intersections with right-angle intersections,

3/ The braking calculations assume a normal perception-reaction time of 1 1/2 seconds, which could have been even less in this case because the signs were visible as signs long before they could be read. Also, even lighter braking actions could have been made because the calculations are based upon arriving at the curve, and the early part of the curve could have been used to slow the schoolbus.

4/ "A Policy on Geometric Design of Rural Highways," American Association of State Highway and Transportation Officials (Washington, D.C., 1965), p. 389-391.

sight distances are improved and turning maneuvers of large vehicles are easier. Figure VIII-2E of the manual depicts an intersection design that is generally identical to the realignment design used by the AHTD. The manual notes that: "The curves introduced, however, should permit safe operations at speeds not much below that on the approaches of the highway, or they may prove to be as great a hazard as the acute angle crossing itself. Special advance warnings should be provided on such curves." The State Highway 214 curve that was constructed at the accident site does not follow the "safe operations at speeds not much below" guidance offered by the AASHTO manual. There is a 20-mph or greater speed difference between the 55-mph approach speed on State Highway 214 and the existing "35 mph" advisory speed posted for the curve by the AHTD. In addition, drivers do not consistently perceive and respond to the "35 mph" advisory speed sign as indicated by the large number of accidents/incidents reported at the public hearing and the visibility tests conducted by the Safety Board following the accident. Consequently, the potential is high that drivers will approach the curve too fast.

Calculations based on the AASHTO guidelines indicate that the design speed of the curve for a 210-foot radius and a 0.09 foot per foot superelevation is 28.6 mph. 5/ Another reference 6/ states that the design speed should be used in determining the advisory speed for a curve. Because it is inadvisable to post an advisory speed that exceeds the design speed, the next lowest increment of 5 mph should be used as the advisory speed. 7/ In this case, the advisory speed should have been 25 mph, instead of 35 mph. The difference between the 55-mph approach speed on State Highway 214 and the calculated 25-mph advisory speed is 30 mph. Based on the large difference between the two speeds, the Safety Board believes that either another intersection design approach should have been considered or extraordinary steps should have been taken to alert drivers to the hazard at this location.

According to AHTD policy, the posted advisory speed is the nearest 5-mph incremental speed that registers 15 degrees or less on a ball bank indicator. The calculated advisory speed for the accident curve based on this requirement is about 30 mph, not 35 mph as posted. Therefore, the advisory speed at the curve was too high and did not comply with State policy or national guidelines.

According to the AASHTO guidelines, safe speeds on curves are indicated by ball bank readings of 14 degrees for speeds below 20 mph, 12 degrees for speeds between 25 and 30 mph, and 10 degrees for speeds 35 mph and higher. 8/ Therefore, there is a discrepancy between the single ball bank indicator reading method used by the AHTD to determine the posted advisory speed and the range of readings and speeds recommended by AASHTO. Such a difference in ball bank indicator readings in this case appears to have permitted the posting of an advisory speed limit that is 5 to 10 mph higher than the speed considered safe by national guidelines.

5/ "Design of Rural Highways," p. 157. Design speed: A speed determined for design as related to the physical features of a highway that might influence vehicle operation. It is the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.
6/ "Transportation and Traffic Engineering Handbook," Institute of Transportation Engineers (Washington, D.C., 1976), p. 860.
7/ Five-mph increments are to be used according to Section 2C-35 of the "Manual on Uniform Traffic Control Devices for Streets and Highways," Federal Highway Administration (Washington, D.C., 1978).
8/ "Design of Rural Highways," p. 154.

All but one of the signs and markings approaching and through the accident site conformed with the lateral and horizontal placement requirements of the Manual on Uniform Traffic Control Devices (MUTCD), an advisory manual issued by the Federal Highway Administration. The "stop ahead" sign was about 500 feet instead of 750 feet before the stop sign as recommended by Section 2C-3 of the MUTCD. However, the Safety Board concludes that this sign probably should have provided adequate warning to an alert driver. Also, because the advisory speed on the sign should have been "25 mph" instead of "35 mph," an advance "turn" sign should have been used instead of the advance "curve" sign.

The primary hazard at this location is the curve. The State's original placement of the arrow sign and delineators in the curve was appropriate since the arrow sign provided redundancy of the message that the road curved to the right and the delineators provided a visual cue to the hazard. However, the delineators apparently were knocked down soon after installation and had not been replaced. The posting of an advisory speed on the curve sign in advance of the curve was also appropriate, but the selected 35 mph speed was too high and might have given a driver wrong information, causing him to choose an inappropriate speed for the curve. If a driver was not alerted by the advisory speed sign and the delineators were not in place, a driver had only the "large arrow" sign and the "stop ahead" sign to alert him, and they were not useful in determining an appropriate speed.

The illusional effect of a straight road rather than a curved road that is introduced when vehicles with their lights on are present on State Highway 18 under dawn or dusk lighting conditions could affect some drivers' judgments on the accident curve. The postaccident tests revealed that headlights from these vehicles can "wash out" visibility of the "large arrow" sign on State Highway 214. A cautious driver who reacted to the "curve" warning sign and "35 mph" advisory speed sign would reduce his speed if he lost the ability to see the road ahead, but a less cautious driver who ignored these previous signs might not reduce his speed until it was too late. The Safety Board concludes that while there are enough visual cues for a cautious driver to maneuver safely through the curve and stop sign, these visual cues could be negated by the illusional and "wash out" effects of State Highway 18 traffic. However, these factors probably did not exist at the time the schoolbus involved in this accident was approaching the curve.

The AASHTO manual does not specifically address the subject of sight obstructions in its discussion of intersection alignment. It does note that, "at many places, site conditions establish definite alignment and grade limitations on the intersecting roads." The location of the store was a critical element in the design of the intersection. It prevented the construction of a higher speed curve at the accident site and it hid the intersection and stop sign from the view of westbound motorists on State Highway 214. Moving or relocating the store would have added significantly to construction costs when the roads were realigned in 1977. The two highways were low-volume roadways, the reported accident rate was low, and construction funds were and continue to be limited. Economic factors prevailed, permitting the store to remain in place and the intersection to be constructed as it was at the time of the accident.

One of the basic principles of intersection design is to favor the direction with the heaviest and fastest traffic flows to minimize hazard and delay. Current traffic patterns on State Highways 214 and 18 are not consistent with the projections made by the AHTD in the mid-1970's. About 90 percent of the traffic on State Highway 18 west of the intersection with State Highway 214 is traffic that traveled on State Highway 214 to the intersection and turned left. The traffic on State Highway 214 already has exceeded the

1990 traffic projections by about 38 percent. While both highways have low traffic volumes, the speeds are high and State Highway 214 is the more active. Also, the 30-mph difference between the calculated advisory speed of 25 mph and the approach speed of 55 mph for State Highway 214 favors realignment of the intersection to make State Highway 214 the through route with State Highway 18 intersecting it at a right angle. Realigning the intersection would also eliminate "illusional" and "wash out" effects on this highway.

The AHTD reported to Safety Board investigators that the traffic patterns indicate that following the former alignment of the two roads and eliminating the State Highway 18 curve would now be the preferred design approach for the intersection. In that way, both highways would be straight, and the north leg of State Highway 18 would lead to a right-angle intersection with State Highway 214 with a stop sign.

As a result of an independent study following the accident, the AHTD installed rumble strips before the combination curve warning and "35 mph" advisory speed sign, and before the "stop ahead" sign on the approach to the curve. During a followup trip through the accident site, a Safety Board investigator noted that traffic was maneuvering into the opposing traffic lane to avoid the rumble strips. The Safety Board commends the AHTD for expeditiously installing the rumble strips and endorses their use. However, the Safety Board believes that driver reactions to the rumble strips should be monitored and that, if a hazard exists, then appropriate changes to the design of the rumble strips should be implemented.

On April 27, 1983, the Safety Board issued the following recommendations to the AHTD:

> Eliminate or reduce the illusional effects of a straighter road and the "wash out" effects of headlight glare on State Highway 214 at the curved approach to its intersection with State Highway 18. (H-83-7)
>
> Further improve the traffic control features on State Highway 214 at the curved approach to its intersection with State Highway 18. (H-83-8)
>
> Identify similar locations with sharply curved approaches to intersections in Arkansas, determine the need for further traffic control improvements, and improve these locations as necessary. (H-83-9)

In response to the Safety Board's recommendations, the AHTD reported that it has installed a "turn" warning sign, reduced the advisory speed sign for the curve to 30 mph, and added a new "symbolic" stop ahead sign. The AHTD also is evaluating all locations that are similar to the accident site.

The Safety Board commends the AHTD for such rapid action, but further improvements are necessary. Upgrading the traffic controls at this intersection might achieve more consistent, appropriate reactions from all drivers. Based on its findings, the Safety Board concludes that the driving conditions on State Highway 214 at the curved approach to State Highway 18 could be improved by:

(1) reducing the speed on the advisory speed sign to "25 mph;"

(2) providing reflectorized delineators at the curve that will not be easily knocked down or removed, such as flexible posts, raised pavement markers, or chevron signs;

(3) eliminating or reducing the described illusional and "wash-out" effects, where practical. For example, it may not be practical to relocate the telephone lines, but other traffic controls or headlight glare screens 9/ may further reduce their illusional influence;

(4) realigning the intersection to define State Highway 214 as the major route; and

(5) evaluating the effectiveness of the signing by speed studies, vehicle path analysis, or a combination of the two. More drastic measures may be required such as oversized signs or beacon lights.

Schoolbus Inspection and Maintenance

The Jonesboro School District's method of inspecting, scheduling, and maintaining schoolbuses, especially for school activity trips, needs detailed review and correction. The trip apparently had been scheduled several weeks before, yet a bus of appropriate size was not made available until the evening before the trip. Members of the group making the trip inspected the bus of their own volition and attempted to repair it in a limited time. The brake, steering, and exhaust systems and the leaking rear-axle differential had been serviced within the last year and either had not been repaired properly or needed additional work. The postaccident inspection indicated that these items needed major repairs. A little over a month before the accident, the regular driver of the bus reported "mushy" brakes. The maintenance report stated that the brakes were checked and fluid added, but it did not give any other details. If the tire, wheel, and brake drum assemblies had been removed to examine the brake system components at that time, it is likely that all leaking wheel brake cylinders would have been replaced, that the improperly installed lower left front brake shoe would have been replaced, and that the brakes would have been adjusted.

Despite two annual inspections and provisions for scheduled and unscheduled maintenance, the bus supplied by the Jonesboro School District was mechanically unsuitable for any long distance, high speed trip. The Jonesboro School District inspects and maintains its buses in accordance with the Federal requirements of Highway Safety Program Standard (HSPS) 17--Pupil Transportation Safety, issued by the National Highway Traffic Safety Administration (NHTSA), and in accordance with the guidelines of the "Program Manual" for implementing HSPS 17. (See appendix D.) However, the school district apparently does not have a procedure in place to determine if needed repairs have been performed adequately or if major repairs are required. HSPS 17 and the "Program Manual" for HSPS 17 also do not address the issue of the quality control of schoolbus repairs. The annual inspections required by State and Federal regulations probably would locate problems but would not necessarily define the extent of the problems. The Safety Board believes that properly inspected and repaired schoolbuses and adequate maintenance facilities are essential to the safe transportation of pupils. The Safety Board also believes that quality control procedures for schoolbus repairs should be instituted in State schoolbus maintenance programs and addressed in HSPS 17 and the "Program Manual" for HSPS 17.

9/ Any type of roadway feature that functions as a physical barrier to direct headlight glare is considered a glare screen, including tall shrubbery, expanded steel mesh fencing, baffles, safety barriers, or mounds of earth.

Neither the Jonesboro School District nor the "Program Manual" of HSPS 17 specificially define the qualifications of schoolbus mechanics or address a continuing program to maintain or upgrade their skills. The mechanic for the Jonesboro School District complied with the general requirements stated in the "Program Manual" for HSPS 17 that mechanics have previous experience and that they attend annual State-approved training. The Safety Board believes that the poor mechanical condition of the schoolbus in this accident suggests that the existing Federal requirements for hiring and training schoolbus mechanics are inadequate.

The Safety Board conducted a telephone survey in August 1983 of the District of Columbia, 13 States, 10/ and 2 trade organizations 11/ on the subject of training, licensing, or certification of schoolbus mechanics. This information was gathered from State Directors of Public Transportation, student transportation contractors, and members of the State Highway Patrol.

A student transportation contractor program in Minnesota is an apprenticeship that consists of 7,000 hours (4 to 5 years) of on-the-job training under the direction of an experienced mechanic. An applicant is required to have previous garage experience. By contrast, Maine does not have any type of apprenticeship but rather a loosely guided, self-instruction type of program. A willingness to learn appears to be the only prerequisite. The remainder of the States surveyed offered on-the-job training which fell somewhere between these two extremes.

Periodic training was offered by 8 12/ of the 14 States in the form of a workshop, seminar, or teleconference, lasting from 1 day to 1 week. Individuals from at least two States remarked that they sent their mechanics out of State to attend workshops of a bus chassis or vehicle component manufacturer. It is also customary for the delivery of a new bus to include instruction on various maintenance aspects of the vehicle.

Many of the States contacted mentioned that the only formal training requirement for bus mechanics involved certification to become a State-approved vehicle inspector. However, this training may be offered to noninspectors, as in Pennsylvania, which held a teleconference on vehicle regulations and inspection procedures to inform all mechanics of the standards they were required to meet. The States surveyed which sponsor mechanical inspector's training are Pennsylvania, New York, Arkansas, and Florida. A number of people surveyed felt that the best way to assure proper bus maintenance is to have frequent and aggressive inspection programs.

Only two States (Hawaii and Michigan) have mandatory mechanics licensing. None of the States surveyed has a statute or regulation requiring schoolbus mechanics to complete any type of standardized training course or requires an applicant to pass any sort of competency test. However, voluntary certification is possible.

In Michigan and in Florida's Dade County, there is a pay rate incentive for mechanics who acquire component or system certification. Many corporate, State, and municipal fleets or garages voluntarily participate in the certification program of the National Institute for Automotive Service Excellence (NIASE). NIASE's heavy truck

---

10/ California, Florida, Iowa, Louisiana, Maine, Michigan, Minnesota, New Hampshire, New York, North Dakota, Pennsylvania, Texas, and Wisconsin.
11/ National Committee for Motor Fleet Supervisory Training and the National School Transportation Association.
12/ Minnesota, Maine, Michigan, Iowa, Texas, Arkansas, Pennsylvania, and New York.

testing program consists of six separate tests, five of which are used to evaluate bus mechanics. In Florida's Dade County, vehicle mechanics are encouraged to take the NIASE tests to identify weaknesses in their training.

From the State survey, it was apparent that the requirements for on-the-job training of schoolbus mechanics vary widely, that periodic training is unstructured, that the only formal training may involve certification to become a State vehicle inspector, and that programs for certification of proficiency in vehicle systems and components exist.

School Activity Trips

The Safety Board has investigated three school activity trip accidents 13/ involving buses in poor mechanical condition, and it believes that continued emphasis must be placed on providing buses that have been thoroughly inspected and are in good mechanical condition. Although there is no evidence to indicate that the Jonesboro School District was aware of the serious mechanical deficiencies of the schoolbus involved in this accident, the Safety Board believes that activity groups should be prevented from starting or continuing trips in mechanically unsafe vehicles.

The only fire extinguisher on the bus was mounted near the driver and was relatively inaccessible after the accident. Students who looked for the fire extinguisher did not know where it was located. Fortunately, the engine compartment fire was small. Either it was extinguished by the passengers using dirt and water from the drainage ditch or it went out on its own. These findings indicate that schools should consider providing an additional fire extinguisher near the rear of the bus, posting signs in schoolbuses on the location and use of emergency equipment, and briefing all passengers about the location and use of emergency equipment, both periodically and before beginning special activity trips.

In a July 22, 1983, memorandum, the Arkansas Department of Education encouraged school superintendents and county school supervisors to direct more attention to preparations for school activity trips. The memorandum listed general requirements including an experienced, licensed, healthy driver; route planning; securing of loose objects; and use of driver seatbelts. It also encouraged the installation of a second fire extinguisher in the rear of the bus. The memorandum did not mention the mechanical condition of the bus to be supplied or how the Arkansas Department of Education would determine if its requirements for school activity trips were being implemented. The Safety Board commends the Arkansas Department of Education for its efforts, but it believes that requirements regarding the mechanical condition of the bus should be established and that all safety requirements for activity trips should be enforced.

Crash Dynamics

As the tire marks and bus damage pattern indicate, the bus was sliding to the left while crossing the centerline in the curve. The rear tires lost contact with the pavement as the bus crossed State Highway 18. The bus was tipping and rolling over when the left front tire reached the far pavement edge of Highway 18. The left front corner of the bus roof impacted the far side of the ditch while the remainder of the bus was airborne.

13/ Highway Accident Reports—"Siskiyou Union High School District Schoolbus/ Automobile Collision and Rollover, Interstate 5, Ashland, Oregon, May 9, 1975" (NTSB-HAR-76-1); "Student Transportation Lines, Inc., Charter Bus Climbing of Bridge Rail and Overturn, Near Martinez, California, May 21, 1976" (NTSB-HAR-77-2); "Overturn of a Ypsilanti, Michigan, Boys Club Bus, Interstate 75, Near Tifton, Georgia, April 11, 1978" (NTSB-HAR-79-2).

The concentration of the impact at the left front corner of the bus roof collapsed the roof structure to the top of the seatbacks for the first four rows of seats on the left side of the bus, substantially invading the available survival space for these occupants (including the driver) and for those directly across the aisle on the right. Since the rear of the bus was airborne when the left front of the bus first struck the ditch, the occupants behind the first four rows of seats struck a relatively flexible and yielding sheet metal roof structure, while those occupying the first four rows of seats on the left struck a rigid, collapsing roof structure with the ground directly benind it. This difference in initial contact surfaces affected the severity of the injuries sustained by the bus occupants. About half of the padded seatbacks were deformed forward, suggesting that energy was absorbed during the crash-imposed occupant kinematics. Occupants were propelled out of their seats in a forward and downward direction into the seatbacks ahead of them and then into the bottom surfaces of the roof.

Schoolbuses manufactured after April 1, 1977, are required by NHTSA regulations to meet certain occupant crash protection standards. All such schoolbuses must meet the requirements of Federal Motor Vehicle Safety Standard (FMVSS) 220—School Bus Rollover Protection and the requirements of FMVSS 221—School Bus Body Joint Strength. Under the requirements of FMVSS 222—School Bus Seating and Crash Protection, schoolbuses having a gross vehicle weight (GVW) of less than 10,000 pounds must provide occupant restraints at each seating location; schoolbuses weighing more than 10,000 pounds GVW must provide for occupant crash protection through the use of strengthened, properly spaced, and padded seats (or "restraining barriers" for front row seats). The seatback height is rigidly defined and varies with the seating reference point and the seat bench width.

For vehicles manufactured in several stages, as large schoolbuses usually are, NHTSA regulations require the final stage manufacturer to decide on the "manufacturing date" to be used in determining which safety standards must be met. The final stage manufacturer may use the manufacturing date of the chassis, the date of the final completion of the vehicle, or any date in between. The final stage manufacturer must state the selected date in a label affixed to the bus.

In this case, the International Harvester Corporation chassis was manufactured in October 1975 and the Ward body was manufactured in May 1977. A label on the bus stated that the manufacturing date was the 1975 date of manufacture of the incomplete bus (the date of manufacture of the chassis). Because the chassis was manufactured in October 1975, and the effective date of the schoolbus standards was April 1, 1977, the completed vehicle was not required to comply with FMVSS' 220, 221, and 222.

Even if this schoolbus had been in compliance with the rollover protection standard, the concentrated longitudinal forces acting on the front of the bus roof would have negated the vertical roof crush integrity required by the standard. Neither the rollover protection standard nor the joint strength standard would have assured a significant degree of additional protection in this crash. The roof structure, the body joints, and the seats to the rear of the initial zone of impact performed exceptionally well under the forces imposed in the accident. The Safety Board has been advised by technically competent industry personnel that FMVSS 222-type controlled yielding seats and/or seatbelts could have been retrofitted into this bus with only minor modifications.

It is doubtful that seatbelts would have prevented the deaths of the driver and the eight occupants seated within the first four rows of the schoolbus. All died of head injuries or head and neck injuries. The concentration of the impact at the left front

corner of the bus roof collapsed the roof structure onto the driver's area and the first four passenger seats on the left to the point that the space available to these occupants and to the occupants of the right side aisle seats in rows 3 and 4 was not sufficient for survival.

It is not clear what effect seatbelts might have had on the severity of the injuries suffered by the occupants of the aisle seats in the first two rows on the right side. Those seated in the window seats in the first four rows on the right side might have suffered less serious injuries if they had been restrained in seatbelts. Some, if not all of the remaining bus occupants probably would have been injured less severely if they had been restrained in seatbelts. All but two of these occupants suffered only minor or moderate injuries, mostly lacerations, contusions, and abrasions, many of which resulted from being tumbled about during the impact and rollover.

If the bus had been equipped with FMVSS 222 seats, the seatback height would have been only 2 to 3 inches higher and the seat spacing would have been no more than 24 inches instead of 27 inches. Those who suffered fatal or serious head or neck injuries would not have benefited from the provisions of FMVSS 222. It is uncertain what effect the FMVSS 222 seat spacing and seatback height requirements might have had on the serious injuries sustained by the occupants of the first two rows on the right side, the right side aisle seat in row 7, or the right side window seat in the last row. The other survivors sustained only minor to moderate injuries when they tumbled during the crash and were hit by luggage and equipment. Some of these injuries might have been prevented or reduced in intensity somewhat by the presence of proper seat spacing and higher seatbacks. For the most part, the seats complied with the general requirements of FMVSS 222: the seats remained firmly attached to the walls and floor of the bus, the seatbacks were completely padded, and the seatbacks yielded upon impact. The Safety Board concludes that FMVSS 222 seats or restraining barriers would not have provided substantially greater protection to the occupants in this crash.

As a result of its investigation of a 1977 school bus crash, 14/ the Safety Board saw a need to gather crash performance data on schoolbuses manufactured under the new standards. The Board recommended that the NHTSA:

> Review available accident statistics involving 1975 and later model schoolbuses equipped with seating arrangements that comply with Federal Motor Vehicle Safety Standard No. 222 to determine if the specific seating, restraining barrier, and impact zone requirements for schoolbuses have reduced the injuries sustained by occupants on these schoolbuses when involved in collisions and rollovers. A report of the findings should be submitted to the National Transportation Safety Board at the earliest opportunity. (H-78-11)

In its June 1978 response to this recommendation, the NHTSA said, "Vehicles built according to the latest rule . . . are just reaching the operators, and considering the safety performance of the national school fleet, it may be several years before a sufficient quantity of data is accumulated." The NHTSA said it would "continue to evaluate the effect of the compartmentalization concept as data are received."

14/ Highway Accident Report--"Tractor-Semitrailer/Schoolbus Collision and Overturn, Rustburg, Virginia, March 8, 1977" (NTSB-HAR-78-1).

Since then, the NHTSA has conducted a statistical evaluation of the effectiveness of the occupant restraint requirements (for small schoolbuses) and the seatback height and padded seat requirements (for all schoolbuses) of FMVSS 222. 15/ However, the analysis was based on inferences drawn from an examination of the injuries sustained in accidents involving schoolbuses built before the effective date of FMVSS 222. No analysis has been performed yet of the real-world accident performance of buses designed to meet the post-1977 schoolbus crash protection standards (primarily FMVSS' 220, 221, and 222).

Schoolbus Driver Training

Arkansas State law appears to require preservice training only for 17-year-old drivers (and then only if the State Board of Education requires such training), but not for all new schoolbus drivers. For schoolbus drivers older than 17, the law requires only the possession of a valid schoolbus driver certificate, obtained through successful completion of the specified tests. The Safety Board has not located any documents other than the Arkansas Department of Education memorandum of July 22, 1983, that indicate that even schoolbus drivers with prior experience must take preservice training.

Based on Arkansas State law, State Board of Education regulations, and the Arkansas Department of Education handbook, and on discussions with Arkansas school transportation officials, it appears that preservice training in Arkansas is required certainly for 17-year-old drivers and probably for all drivers without experience in schoolbus driving, and that it is the responsibility of local school officials to provide that training. Although the State-recommended length of this preservice training is substantially less than that recommended by Federal guidelines, the Arkansas requirement appears to be consistent generally with HSPS 17. (See appendix D.)

Although it appears that the schoolbus driver in this accident should have been included in the in-service training required for "all" drivers in the county where the Jonesboro School District is located, there is no record that he received either preservice or in-service training. However, he was a healthy, experienced busdriver who had no record of poor driving. He was not a driver "whose primary duties involve the transportation of school pupils" (to whom the requirements of HSPS 17 apply); he possessed a valid schoolbus driver's certificate. There is no reason to believe his lack of formal schoolbus driver training contributed in any way to this crash or to the severity of its consequences.

15/ "Statistical Evaluation of the Effectiveness of FMVSS 222: School Bus Seating and Crash Protection" (DOT-HS-8-02014, October 1980).

CONCLUSIONS

Findings

1. The driver was a healthy, experienced driver who had no previous record of poor driving.

2. There was no evidence that the driver suffered a sudden medical problem on the approach to the curve or that he was impaired by fatigue, exhaust fumes, or other similar factor.

3. The schoolbus was in poor mechanical condition when assigned to the trip on the afternoon before the accident.

4. There was no evidence to suggest that the mechanical condition of the schoolbus contributed to the accident.

5. The illusional or "wash-out" effects of State Highway 18 traffic probably were not present in this accident.

6. Drivers approaching the curve would experience problems controlling their vehicles at the accident site if they ignored the basic intent of the signs on the approach to the curve or were operating over the speed limit.

7. The busdriver's lack of response to the traffic control signs approaching the curve was not an uncommon driver reaction.

8. The design of the curve and intersection was deficient and was the foundation for the traffic control problems that evolved.

9. The posted "35 mph" advisory speed was too high and did not comply with State policy or national guidelines.

10. Improved traffic controls at this intersection are necessary and might achieve more consistent, appropriate reactions from all drivers.

11. The Jonesboro School District's method of inspecting, maintaining, and scheduling schoolbuses, especially for school activity trips, needs detailed review and correction.

12. The requirements of HSPS 17 and the "Program Manual" for HSPS 17 do not address the issue of the quality control of schoolbus repairs.

13. The "Program Manual" of HSPS 17 does not specifically define the qualifications of schoolbus mechanics or address a continuing program to maintain or upgrade their skills.

14. It is doubtful that seatbelts would have prevented the deaths of the driver and the eight occupants seated within the first four rows of the schoolbus.

15. A later model bus, meeting the current Federal crash protection standards for schoolbuses, would not have substantially reduced the injuries.

16. Arkansas' recommended length of preservice training for schoolbus drivers is substantially less than that recommended by Federal guidelines but the State's requirements in general appear to be consistent with HSPS 17.

17. The driver's lack of formal schoolbus driver training was not a factor in this accident.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the driver's failure to slow the schoolbus to a proper speed for negotiating a curve that led to a T-intersection with a stop sign and that had advance "curve" and "stop ahead" warning signs and an advisory speed sign. Contributing to the accident were the deficiencies of the intersection design and signing system, and the lack of reporting of a large number of low severity accidents and incidents at the curve that would have effectively alerted the Arkansas Highway and Transportation Department to deficiencies in the intersection design and signing system.

RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board recommended that:

--the Arkansas Highway and Transportation Department:

Revise the ball bank indicator readings used to select and post advisory speeds for curves to conform to the guidelines published by the American Association of State Highway and Transportation Officials. (Class II, Priority Action) (H-83-42)

Determine if the design of the rumble strips installed at the approach to the curve on State Highway 214 has created a hazard because of traffic maneuvering into the opposing traffic lane to avoid the rumble strips, and take action to correct the problem if it is determined that a hazard exists. (Class II, Priority Action) (H-83-43)

--the National Highway Traffic Safety Administration:

Include in Highway Safety Program Standard (HSPS) 17--Pupil Transportation Safety and in the "Program Manual" for HSPS 17 the requirement that the States institute quality control procedures for schoolbus repairs to determine if needed repairs have been performed adequately or if major repairs are required. (Class II, Priority Action) (H-83-44)

Include in the "Program Manual" of Highway Safety Program Standard 17--Pupil Transportation Safety:

1. Specific, well-defined qualifications for hiring schoolbus mechanics;

2. Specific skill areas for schoolbus mechanics for which certification of proficiency is required;

3. A bibliography of available courses which can be attended or course curricula which can be used as an example to obtain certification of proficiency in the required skill areas;

4. A requirement to institute and enforce procedures to prevent school activity groups from organizing, beginning, or continuing trips in mechanically unsafe vehicles; and

5. Requirements to place fire extinguishers at the front and rear of schoolbuses, post signs in schoolbuses on the location and use of emergency equipment, and brief passengers on the location and use of emergency equipment, both periodically and before beginning activity trips.

(Class II, Priority Action) (H-83-45)

--all States and the District of Columbia:

Upgrade the quality of schoolbus inspection and repair by examining and revising, as required, the qualifications and training of and facilities for inspectors and mechanics and by instituting quality control procedures to determine if needed repairs have been performed adequately or if major repairs are required. (Class II, Priority Action) (H-83-46)

Institute and enforce procedures to prevent activity groups and drivers from organizing, beginning, or continuing trips in mechanically unsafe vehicles. (Class II, Priority Action) (H-83-47)

Place fire extinguishers at the front and rear of schoolbuses, post signs in schoolbuses on the location and use of emergency equipment, and brief passengers on the location and use of emergency equipment, both periodically and before beginning activity trips. (Class II, Priority Action) (H-83-48)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ DONALD D. ENGEN
Member

FRANCIS H. McADAMS and G. H. PATRICK BURSLEY, Members, did not participate.

September 20, 1983

APPENDICES

APPENDIX A

INVESTIGATION

The Safety Board was notified of this accident at 8:05 a.m. on March 25, 1983, by the Arkansas Governor's Safety Representative. Investigators were dispatched from Safety Board headquarters in Washington, D.C., and from the Safety Board's Field Office in Kansas City, Missouri.

Parties to the investigation were the Arkansas State Police, Arkansas Highway and Transportation Department, American Transportation Corporation (formerly Ward), International Harvester Corporation, Mr. J. Humphreys (a consultant for the National Highway Traffic Safety Administration), and J & O Diesel, Inc.

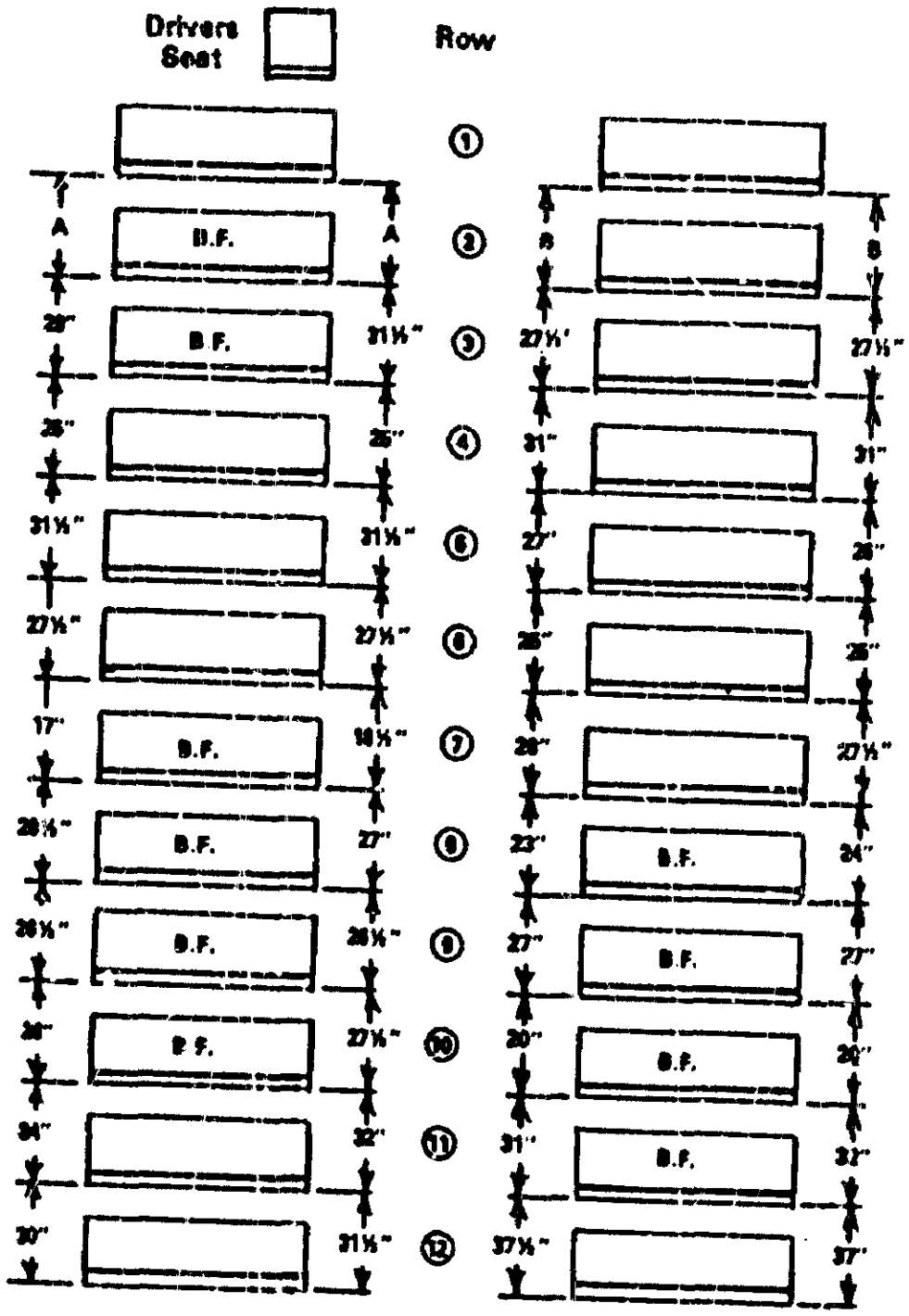
The Safety Board did not hold a public hearing in connection with this investigation, and no depositions were taken. The Arkansas Highway and Transportation Department held a public hearing on March 29, 1983.

APPENDIX B

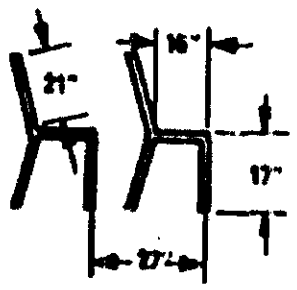
SEATBACK DEFORMATIONS

B.F. – Seat Back Bent Forward

All Measurements from Back of Seat Rest to Back of Seat Rest – Not to Scale



A. Seat Legs Cut on Row ① Seat -No Measurement
B. Seat Missing – No Measurement
C. Basic Seat Dimensions –



Seat Width -- 20"

APPENDIX C

SCHOOLBUS PASSENGER SEATING LOCATIONS AND INJURIES (NONFATAL)

Abbreviated Injury Scale (AIS) 1 Injuries (Minor)

Row 5, left side, window: male, age 18.
Backstrain and scratched right hand.

Row 6, left side, window: male, age 18.
One-quarter inch laceration of left parietal area. Lower half of thorax (posteriorly) and on left is bruised and tender. Left lung appears exp[illegible]ded.

Row 6, right side, aisle: female, age 16.
Tenderness over lower lumbar area.

Row 7, right side, window: male, age 17.
Complains of stiffness all over, abrasion right elbow. Pain in lower back and left elbow. Multiple contusions and abrasions.

Row 8, left side, window: female, age 17.
Superficial laceration of left eye just under eyebrow. Abrasion of right wrist. Neck stiff. Abrasion to left ankle. Swelling over right side of forehead. Neck is tender posteriorly.

Row 8, left side, aisle: female, age 18.
Complains of pain in back of head. Right eye swollen nearly shut. Edema of both eyelids of right eye. X-ray shows fracture of nose.

Row 9, left side, window: female, age 16.
Pain over lumbar spine and left shoulder. X-ray of lumbar spine, scoliosis minimal, otherwise normal.

Row 9, left side, aisle: female, age 17.
Discomfort in left upper humeral area. Tenderness across the lower lumbar area. Avulsion of left humeral head.

Row 10, left side, window: female, age 17.
Complains of injury to left elbow and knot on top of head. Pain crest of left ilium, left elbow and left shoulder. Multiple abrasions and contusions.

Row 10, left side, aisle: female, age 17.
Neck pain. Right shoulder pain. Left clavicle area is tender.

Row 10, right side, aisle: male, age 18.
Laceration on left palm. Contusion of lumbar muscle; contusion to the left thigh.

Row 11, right side, aisle: male, age 17.
Soft tissue injury to right shoulder and lumbar sacral strain.

Row 11, right side, window: male, age 18.
Small laceration of right knee and tender left elbow and wrist.

Row 12, left side, window: male, age 18.
Left corneal abrasion.

Row 12, right side, aisle: male, age 19.
Pain in left side and left calf. Multiple abrasions and contusions.

AIS 2 Injuries (Moderate)

Row 3, right side, window: male, age 17.
Blunt abdominal trauma. Fracture T12. Possible fracture of left scapula.

Row 7, left side, window: male, age 18.
Fracture of lumbar spine (L-5).

Row 8, right side, window: female, age 16.
Compression fracture of T12, L2. Laceration of tongue.

Row 9, right side, aisle: female, age 17.
Complains of low back pain. Small soft lump on right side of forehead, marked tenderness. X-ray showed thoracic and lumbar spine fractures.

Row 11, left side, window: male, age 19.
Complains of pain in left shoulder and above both knees. Fractured left clavicle.

AIS 3 Injuries (Serious)

Row 4, left side, window: male, age 16.
Cerebral contusion, fracture of left clavicle, pneumonia.

Row 4, left side, aisle: male, age 16.
Abdominal trauma, cerebral contusion, undisplaced fracture of left ilium and persistent minimal left pneumothorax.

Row 4, right side, window: female, age 16.
Chest trauma. Multiple trauma, fracture T8, T9, T10. Right and left 11th rib posteriorly, left hemithorax. Blunt trauma, abdomen.

Row 7, right side, aisle: male, age 18.
Dislocated right hip and retroperitineal hemorrhage.

Row 12, right side, window: male, age 18.
Fracture of C-3 with 50 percent compression. Burst fracture of L2, lamina, fracture of L3, lamina fracture of T12.

AIS 4 Injuries (Severe)

Row 1, right side, window: female, age 40.
Complains of abnormality of right wrist. Bruises and abrasions, left hand and left leg. Pain in back. Fracture of right distal radius by X-ray. Ruptured spleen.

Row 2, right side, window: female, age 16.
Ruptured spleen. Seven and a half cm laceration on left forehead, and concussion. Small fracture, right wrist. Hairline fracture of two ribs, right side.

Row 2, right side, aisle: female, age 18.
Pain across lower abdomen, back and right hand. Ruptured spleen.

AIS 5 Injuries (Critical)

Row 1, right side, aisle: female, age 30.
Comminuted fracture of supracondylar. Fracture of first rib with pneumothorax. Fracture of left clavicle. Head injury.

APPENDIX D

HIGHWAY SAFETY PROGRAM STANDARD 17
PUPIL TRANSPORTATION SAFETY

Requirements for Schoolbus Drivers and Vehicle Maintenance

Highway Safety Program Standard (HSPS) 17—Pupil Transportation Safety, promulgated by the National Highway Traffic Safety Administration (NHTSA) in early 1974, states:

> Each State, in cooperation with its school districts and its political subdivision, shall have a comprehensive pupil transportation safety program to assure that school vehicles are operated and maintained so as to achieve the highest possible level of safety.
>
> Each State shall develop a plan for selecting, training, and supervising persons whose primary duties involve transporting school pupils, in order to assure that such persons will attain a high degree of competence in, and knowledge of, their duties.
>
> Every person who drives a schoolbus shall, as a minimum:
>
> (1) Have a valid State driver's license to operate such a vehicle;
>
> (2) Meet all special physical, mental, and moral requirements established by the State agency having primary responsibility for pupil transportation; . . .

The standard also states that each State shall maintain vehicles in safe operating condition through a systematic preventive maintenance program, inspect school vehicles semiannually, and require drivers to perform pretrip inspections and to report in writing any defects or deficiencies.

Implementing the Schoolbus Driver Requirements of HSPS 17

The "Program Manual" developed by the NHTSA as a guide for States and their political subdivisions to use in developing highway safety program policies and procedures conforming to the requirements of HSPS 17 states:

> Every driver of a school bus should have instruction before being allowed to operate a bus loaded with children. This instruction should be of two types, classroom instruction and behind the wheel instruction. The length of the instructional program should be determined by the experience of the driver applicant.

This instruction is considered "preservice training," and the program manual says it should be "at least 40 hours for applicants who have never driven heavy equipment." All other driver applicants "should be required to demonstrate knowledge and skill" in the areas covered in the recommended preservice training program. The manual goes on to state, however, that "all applicants should have supervised instruction behind-the-wheel first with the bus empty and then with children aboard. Length of instruction to be commensurate with ability." (Emphasis added)

In-service training for a schoolbus driver is not required specifically by HSPS 17. However, the program manual for this standard discusses the need for in-service training, suggesting that its "content can be designed around drivers' problems and local school conditions and regulations." The manual suggests a minimum of 8 hours of such in-service training each year.

Implementing the Vehicle Maintenance Requirements of HSPS 17 as defined by the NHTSA "Program Manual"

1. State responsibility - In part, the State should provide assistance to school administrators, contractors, and others in evaluating bus garages and maintenance facilities and in establishing safe vehicle inspection and maintenance practices.

2. State agency with primary responsibility for pupil transportation - In part, this agency should develop and implement educational programs and materials for school vehicle mechanics and provide advisory services to local school units on selecting and drawing up specifications for school vehicles, planning a maintenance shop, and planning a training program.

3. Pretrip inspection - In part, the pretrip inspection covers exhaust system, tires, wheels, brakes, lights, mirrors, doors. All defects should be corrected before the bus transports children.

4. Program evaluation - All facets of the State's Pupil Transportation Safety Program should be evaluated periodically in accordance with the essential and flexible criteria listed in the program manual. The repair and maintenance of transportation equipment (under the provisions of a preventive maintenance program) are included in one of eight essential criteria. The requirements for mechanics fall under flexible criteria. Mechanics are required to have previous experience; attend State-approved annual training; and be employed full time throughout the year on the basis of 1 mechanic per 15 (or less) vehicles. The maintenance program also falls under flexible criteria. The requirements state, in part, that the repair facility should be adequate, that buses should be inspected for possible mechanical deficiencies on a regular basis, and that records of mechanical repairs are maintained for each schoolbus.