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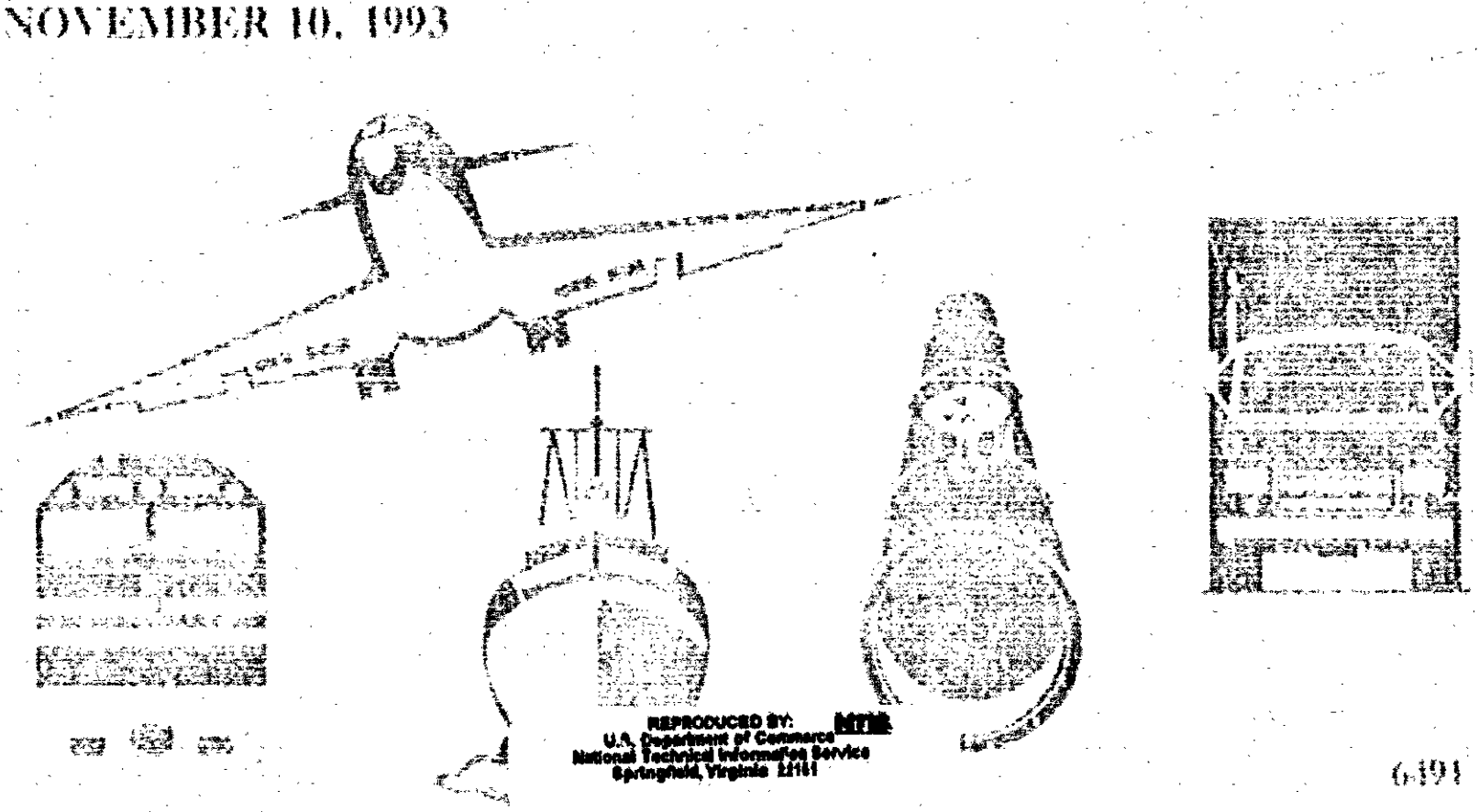
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

COLLISION OF SMALL SCHOOL BUS
AND TRACTOR-SEMITRAILER
NEAR SNYDER, OKLAHOMA
NOVEMBER 10, 1993



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Abstract: On November 10, 1993, a tractor-semitrailer traveling southbound on U.S. Route 183 near Snyder, Oklahoma, struck a 20-passenger school bus that was crossing the highway while traveling west on County Line Road. The side collision killed four of the nine children on the bus. The other five children and the two drivers sustained injuries ranging from minor to severe.

The safety issues identified in this accident are the protection provided school bus occupants, the performance of the school busdriver and the view obstruction in the bus, the performance of the truckdriver, and the adequacy of motor carrier oversight.

As a result of the investigation of this accident, the Safety Board issued recommendations to the National Highway Traffic Safety Administration, the Federal Highway Administration, the Governors of the 50 States and the mayor of the District of Columbia, the National Association of State Directors of Pupil Transportation Service, and the Cornell Construction Company.

COLLISION OF SMALL SCHOOL BUS AND TRACTOR-SEMITRAILER NEAR SNYDER, OKLAHOMA NOVEMBER 10, 1993

HIGHWAY ACCIDENT REPORT

Adopted: November 29, 1994
Notation 6491

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20594

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EXECUTIVE SUMMARY

About 3:28 p.m. on November 10, 1993, near Snyder, Oklahoma, a tractor-semitrailer traveling southbound on U.S. Route 183 struck a 1993 Thomas Built Minotour school bus that was crossing the highway while traveling west on County Line Road. The 20-passenger school bus was occupied by the driver and nine children. The school busdriver said that she stopped at the stop sign and then proceeded to drive across Route 183. The truckdriver stated that the school busdriver hesitated and then pulled out in front of his truck. The school bus was struck in the right side behind the right-front entrance door. Eight children were not wearing the available lapbelts and were ejected. Four of the ejected children died; the injuries of the other four ranged from minor to serious. One child, the only occupant of the bus who was restrained, was not ejected; he received minor injuries. The school busdriver was not ejected, but she was not wearing the lap-shoulder restraint and sustained severe injuries from contact with various parts of the bus interior. The truckdriver, who stated that he was wearing his lapbelt, received minor injuries.

The National Transportation Safety Board determines that the probable cause of the accident was that the school busdriver did not see the approaching truck because her view was obstructed, because she had not been provided with an effective strategy or other means for overcoming the view obstruction, and because she may have been distracted by the unruly passengers. Contributing to the severity of the accident were the truckdriver's failure to observe the speed advisory and the Cornell Construction Company's failure to systematically maintain the accident truck.

The safety issues identified in this accident are the protection provided school bus occupants, the performance of the school busdriver and the view obstruction in the bus, the performance of the truckdriver, and the adequacy of motor carrier oversight.

As a result of the investigation of this accident, the Safety Board makes recommendations to the National Highway Traffic Safety Administration, the Federal Highway Administration, the Governors of the 50 States and the mayor of the District of Columbia, the National Association of State Directors of Pupil Transportation Service, and the Cornell Construction Company.

INVESTIGATION

The Accident

About 3:28 p.m. on November 10, 1993, a tractor-semitrailer traveling southbound on U.S. Route 183 near Snyder, Oklahoma, struck the right side of a 20-passenger 1993 Thomas Built Minotour school bus. The school bus was crossing the highway while traveling west on County Line Road. The weather was clear and the road was dry.

School Bus -- About 3:15 p.m., on November 10, 1993, the 20-passenger school bus left the Snyder Elementary and High Schools with 11 children, ranging in age from 5 to 14, on its route to take the children home. The school busdriver and three students said that during the trip some of the children were "bickering," "mouthing off," and "hollering" at each other. The school busdriver stated that she dropped two boys off at their homes. When she stopped at the second boy's house, about 3 1/2 miles from the accident site, she moved a boy from the rear of the bus to the seat behind her because the boys were fighting. She then drove to the intersection of County Line Road and Route 183. She said that she stopped at the stop sign, put the bus in park, turned around, and checked on the boy she had moved to make sure he was still in the seat behind her. She scolded the children and told them to behave. She told a 5-year-old boy, who was turned sideways in his loosened lapbelt, to get his feet out of the aisle and tighten his lapbelt; he did so. The children stated that the school busdriver did not get out of her seat and that she dealt with the children in a calm and patient manner.

The school busdriver stated that she then put the bus in drive and looked left and right. She said that she rolled forward slowly while accelerating slightly. She said that she looked left and right again, did not see anything on the highway, accelerated more, and proceeded into the intersection. She stated that the sun was shining brightly on the dirty windshield and that she was thinking she should wash the bus when she finished the route. She said that as she moved into the intersection, she looked up into the rearview mirror to make sure that other children were not picking on the boy she had transferred to the seat behind her. When she was in the middle of the intersection, she said that she looked left and then looked right and saw something white at the right-front entrance door and heard the crash.

A 9-year-old boy, who was seated in the right-front window seat, said that after the school busdriver had started into the intersection, he saw the truck coming and yelled "Stop!" and the driver responded "Why?" just before they were struck. (The school busdriver does not recall this exchange.) The boy also stated that the school busdriver was facing straight ahead while they were crossing the intersection.

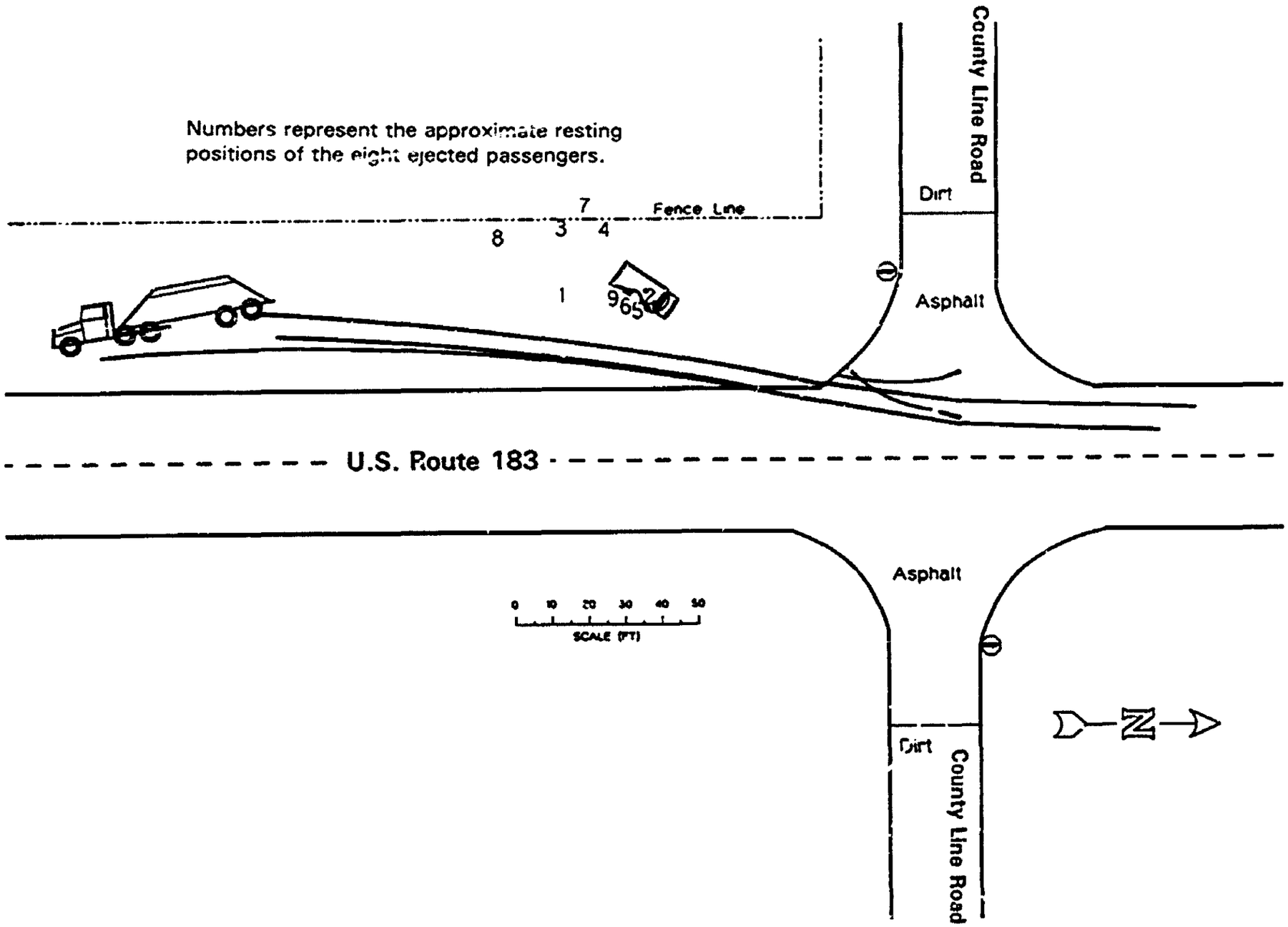

Figure 1. -- Postaccident diagram.

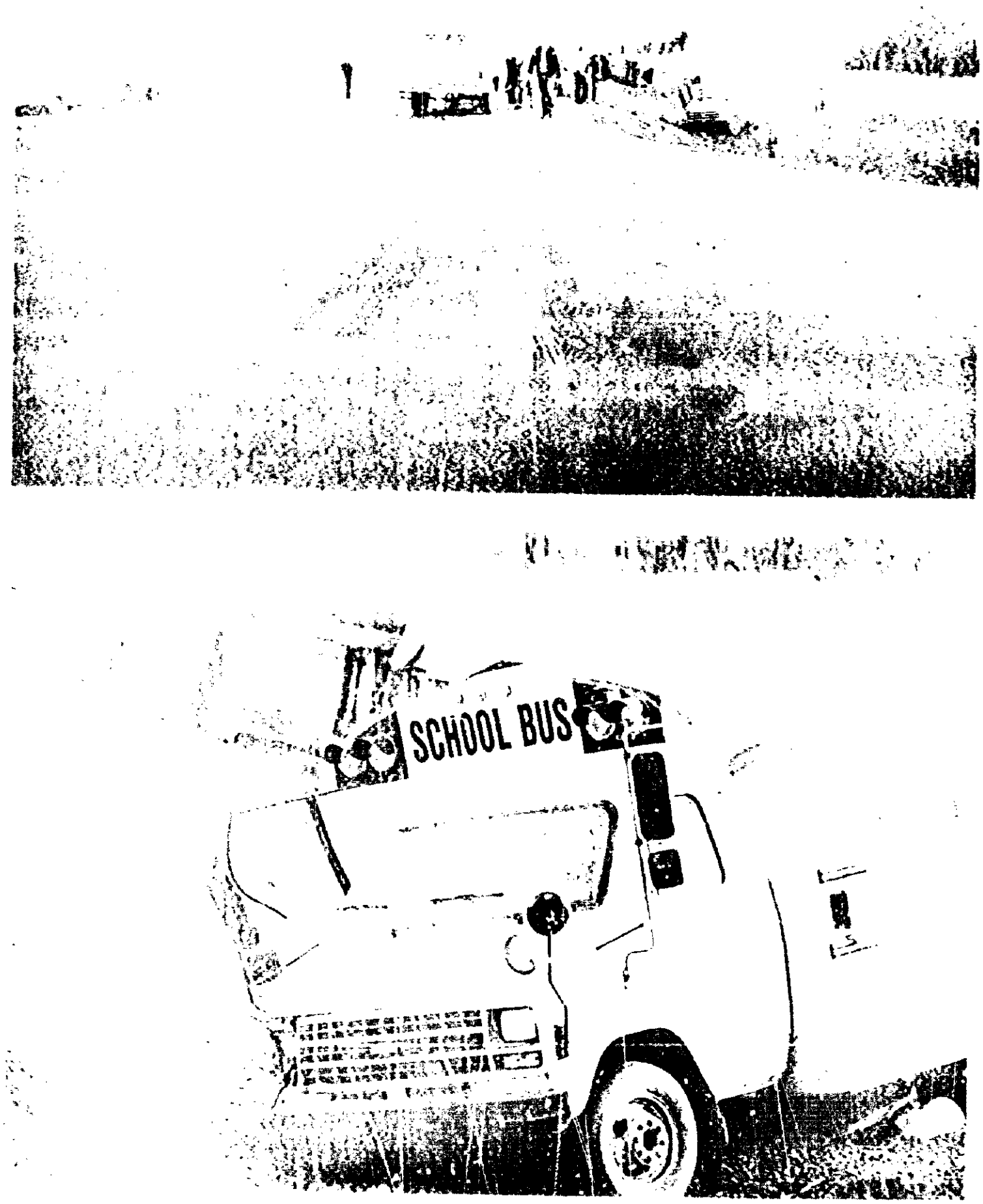

Figure 2. — Postaccident scene.

Injuries

Type of Injury	Drivers	Passengers	Total
Fatal	0	4	4
Serious	1	3	4
Minor	1	2	3
Total	2	9	11

This table is based on the injury criteria[2] of the International Civil Aviation Organization, which the Safety Board uses in accident reports for all transportation modes. An injury table based on the Abbreviated Injury Scale (AIS) of the Association for the Advancement of Automotive Medicine is shown in appendix B.

Vehicle Information

School bus -- The 1993 Thomas Built 20-passenger Minotour had a General Motors chassis, a 6.2-liter diesel engine, automatic transmission, and hydraulic-powered 4-wheel antilock brakes. Its gross vehicle weight rating (GVWR) was 10,000 pounds. When the accident occurred, its estimated weight was 8,324 pounds, and the mileage was 12,682. The school bus was approximately 18 feet long, 8 feet wide, and 8 feet high. It had a 125-inch wheelbase.

The 20-passenger school bus had four rows of bench seats. The first and second rows consisted of four 3-passenger seats, and the third and fourth rows consisted of four 2-passenger seats. The school bus was equipped with a 3-point lap-shoulder belt (automatic-locking retractor) for the driver and a 2-point lapbelt for each passenger seating position.

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[2]Title 49 *Code of Federal Regulations* (CFR) 830.2 defines *fatal injury* as "Any injury which results in death within 30 days of the accident" and *serious injury* as an injury that "(1) Requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second or third degree burns, or any burn affecting more than 5 percent of the body surface."

This small[3] school bus consisted of a school bus body on a modified GM van chassis. The 6-foot-wide van chassis was joined to the 8-foot-wide school bus body by two L-shaped vertical support structures, one on each side of the bus. On the left side, the support structure was just to the rear of the driver's door. On the right side, the support structure was slightly forward of the driver's seat because of its placement between the folding entrance doors on the bus body and a triangular window added to the van body. For a school busdriver sitting in the normal driving position, the right-side support structure created a view obstruction 8 1/2 inches wide. Most small school buses have the same configuration.

Safety Board investigators conducted a postaccident inspection of the school bus and found no mechanical defects.

Tractor-Semitrailer -- The conventional tractor was a 1985 Peterbilt 3-axle chassis with a diesel engine, 13-speed manual transmission, power steering, and air mechanical brakes. The semitrailer was a 1974 Flow-Boy 39-foot dump unit. The combination unit was 58 feet long and 8 feet wide. At the time of the accident, the semitrailer was carrying 31,980 pounds of crushed granite, and the estimated weight of the tractor and its loaded semitrailer was 66,500 pounds. It was owned by the Cornell Construction Company, Inc., (Cornell) in Clinton, Oklahoma.

Safety Board investigators conducted a postaccident mechanical inspection of the combination unit. Except for two tires, the tire pressures ranged between 86 and 96 pounds psi, as required by 49 CFR 570.62 (a). The left tire of the first axle was flat, and the right outside tire of the third axle had 52 psi. The Safety Board later determined that the loss of pressure in these two tires was due to the impact. The tire tread depths ranged between 4/32 and 20/32 of an inch, as required by 49 CFR 393.75 (b) and (c). No defects were noted in the pitman arm, steering gear, drag link, steering arms, or the suspension system.

The inspection revealed that four of the six brakes on the tractor and three of the four brakes on the semitrailer were out of adjustment. (The results are charted in appendix E--Safety Board Postaccident Inspection of the Tractor-Semitrailer Brake System.) The investigators found other defects in the braking system. The S-cam rollers on the brakes on axle 1 had an accumulation of dirt and grease. The brake drums on axle 2 had moderate heat-checking[4] and a 3/8-inch lip between the friction surfaces and the outer edges. A drag test demonstrated that the brake on the right side of axle 2 would not lock the wheel. The brake drum on the left side of axle 3 had minor heat-checking, and the lining on the brakeshoe had a transverse crack that extended from rivet hole to rivet hole. The brake drum on the right side of axle 3 had light heat-checking, and the lining had cracks on both sides.

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[3]Small school buses and vans do not have to meet all the Federal standards that apply to large school buses. See appendix D--Differences in Federal Motor Vehicle Safety Standards for Small and Large School Buses.

[4]Small lines indicating that the brakes had been subjected to extreme heat; heat-checking is usually evidence of emergency braking.

Vehicle Damage

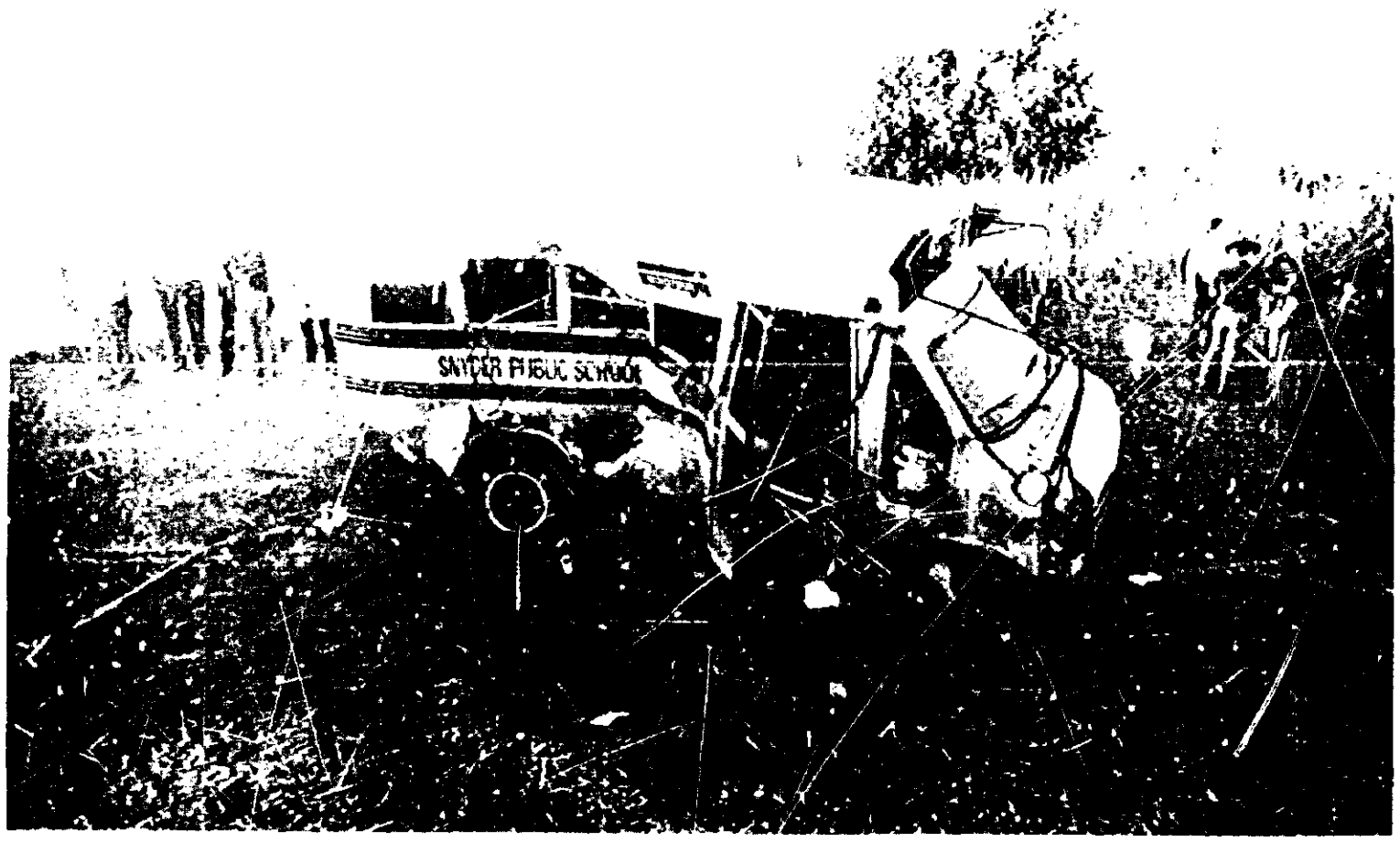
School Bus -- Most of the damage was along the right side of the bus. (Figure 3 shows a view of each side.) The deformation began 7 inches from the right-rear corner and extended forward for 139 inches, ending at the forward hinge of the folding entrance doors. Contact damage between the bus and the front of the truck began 22 inches from the right-rear corner and extended forward for 96 inches (approximately the width of the tractor), stopping at the rear of the folding entrance doors. In this contact area, an imprint from the right side of the truck bumper was visible on the sheet metal. The maximum intrusion into the right side of the bus was 29 inches.

The right-side window frames were deformed, and the window glass was missing. The right side and top of the roof were creased. The right-front entrance door was deformed; the rear portion of the bilateral door was hanging outward, and the front portion was twisted and bent and lying on the ground. The right-front and right-rear bottom corners of the bus were crushed.

On the right side of the bus, the front, rear, and roof were splattered with dirt, but the left side was clean. The impact area was also free of dirt. Hairs were embedded in the cracked front windshield. Both front and rear on the interior right sidewall, blood was splattered near the roof. Near the top of the exterior right-rear sidewall, one area was creased and "clean," and white striation marks angled downward; another area immediately to the right was smeared with tissue and blood.

Figure 4 shows two views of the bus interior. The floor under rows 1, 2, and 3 was displaced upward. The seatframe in row 1 was displaced upward, and the seat cushion was lying on the floor in front of the seat. The seatframe in row 2 was pushed inward across the aisle, up against and overlapping the seat opposite on the left side; the seat legs were bent but were still anchored to the floor. The seat in row 3 was pushed inward 29 inches and had rotated clockwise; the seat cushion was separated from the frame. The seat in row 4 was displaced inward 6 inches. Neither the seatbacks nor the seat cushions were significantly damaged.

Tractor-Semitrailer -- The photographs in figure 5 show the damage to the tractor-semitrailer. The front bumper of the tractor was displaced rearward and about 3 inches to the right. The fenders, hood, and grill were displaced 4 to 5 inches rearward. The windshield glass was broken. Yellow paint transfers were on the bumper, the hood, and the passenger steps of the tractor. The right side of the tractor was crushed when the truck overturned. The semitrailer was intact except for scrape marks and creasing on the right side.



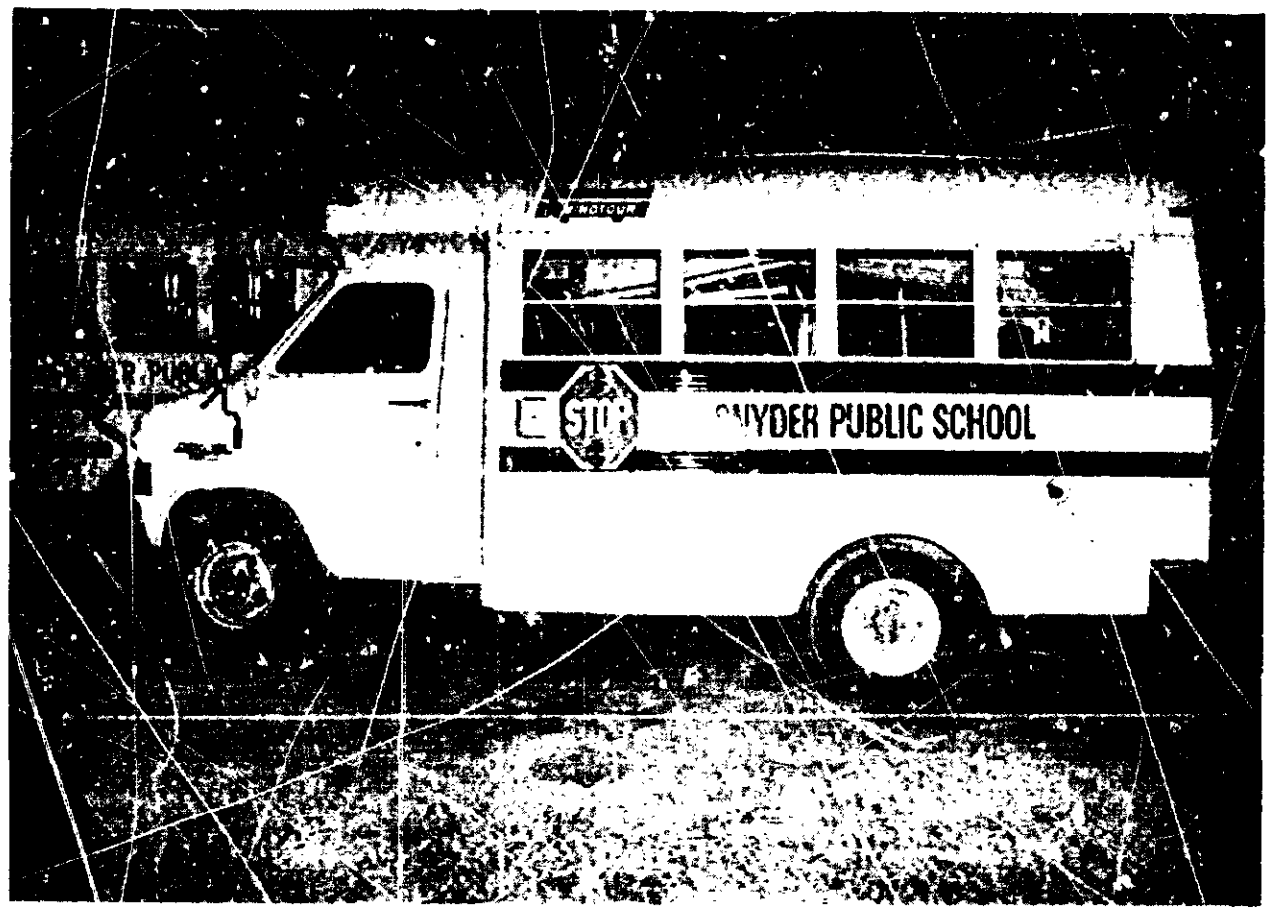


Figure 3. -- Right and left views of the school bus after the accident.

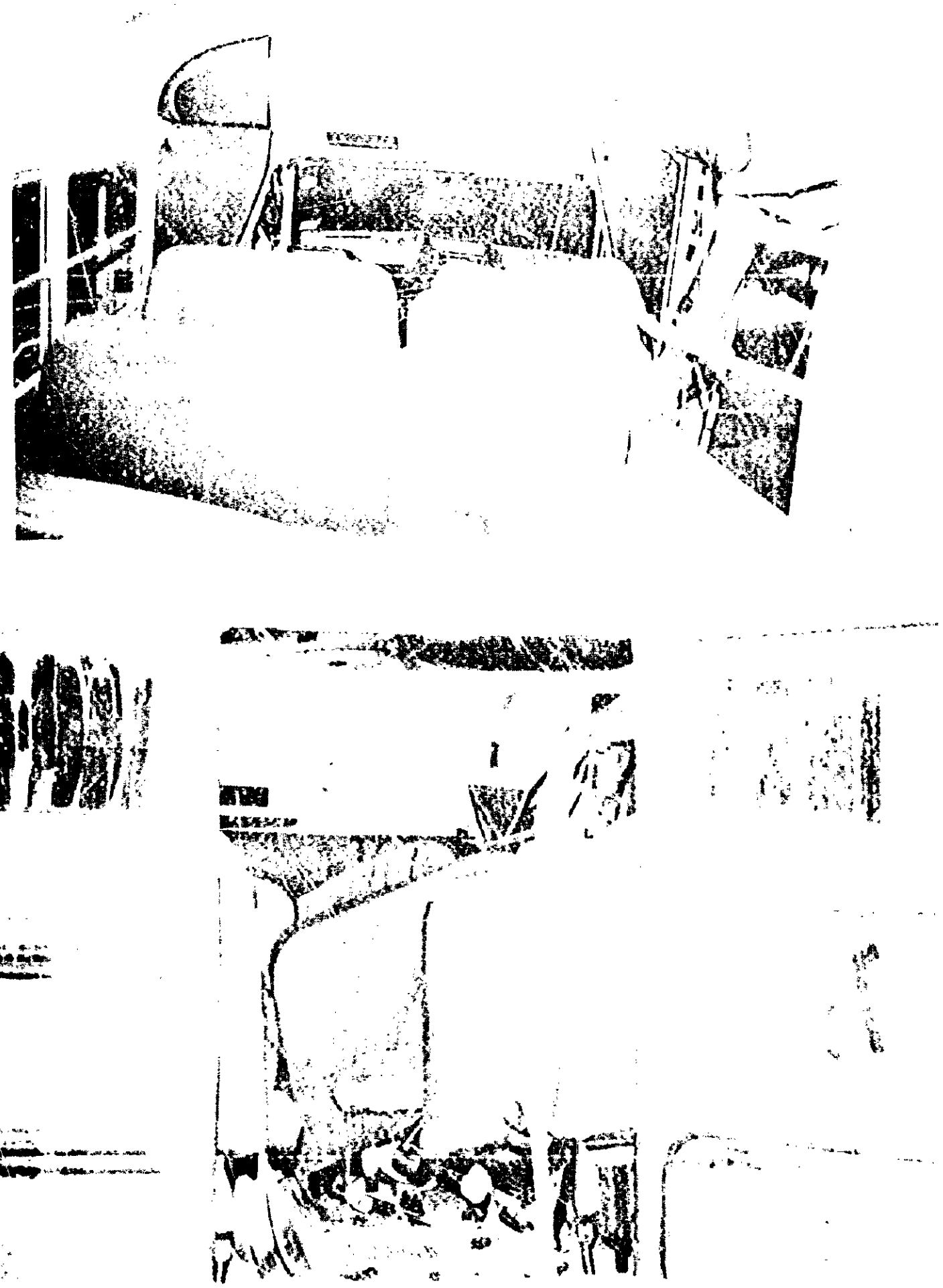


Figure 4. - The interior of the school bus.

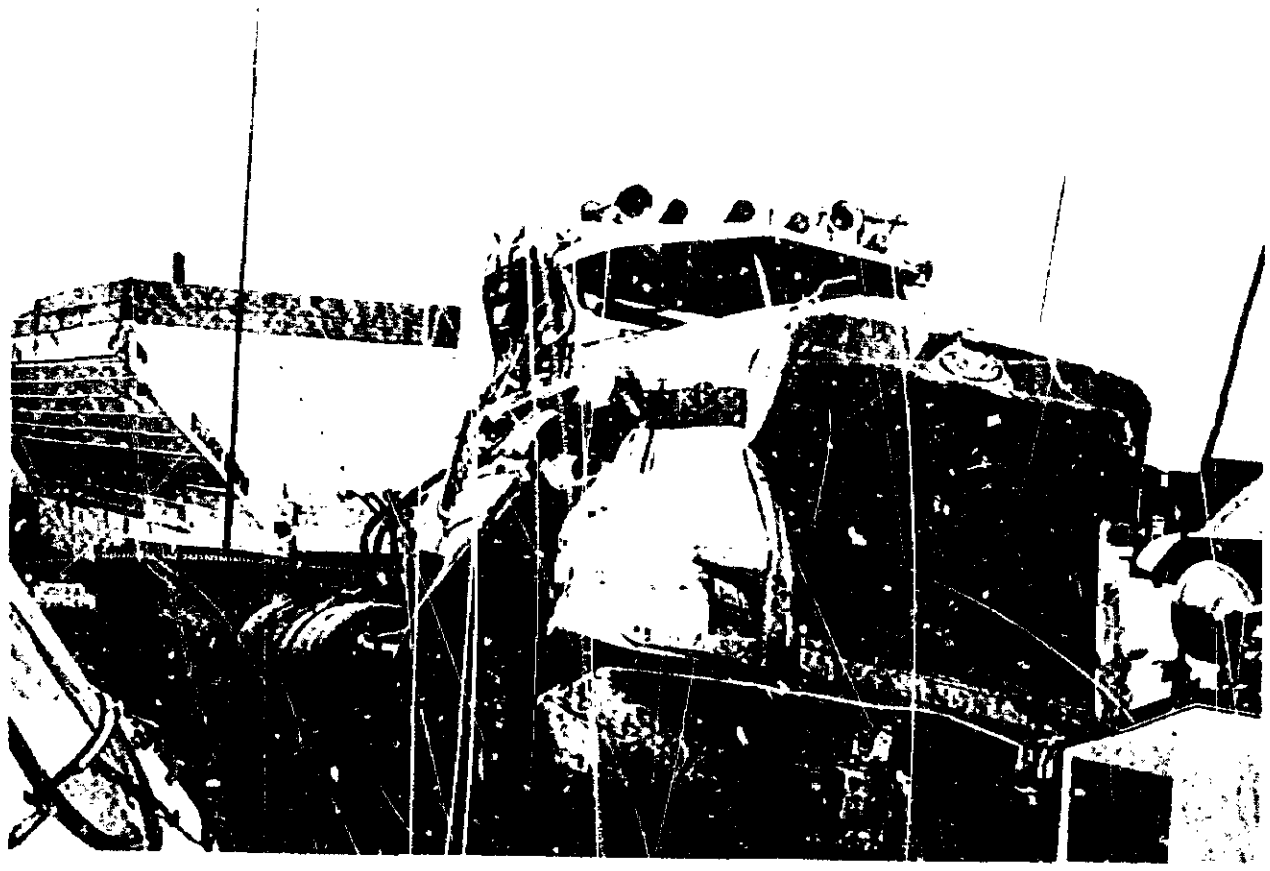


Figure 5. -- The tractor-semitrailer after the accident.

School Busdriver Information

General -- In October 1993, the month before the accident, the school busdriver, 45, took the physical examination required annually for State certification. The examining physician told Safety Board investigators that she had normal hearing, normal vision without corrective lenses, and no disqualifying disabilities or diseases. The school busdriver's husband stated that neither he nor his wife had personal problems.

72-Hour History -- On Wednesday, the day of the accident, the school busdriver worked as a substitute teacher at the high school in addition to driving her school bus route in the morning. She awakened about 6:00 a.m. Her husband drove her to the bus storage lot before 7:00 a.m., and she began her route. After completing the route, she stopped at her father-in-law's house to pick up her usual breakfast of eggs, bacon, and toast. She took the breakfast to the high school, where she reported for the substitute assignment. She ate lunch at the school cafeteria and then used some free time to visit her husband at his place of business. She conversed with her husband and a friend until she returned to the school. Her husband said that she was in "good spirits" during the visit. Her supervisor stated that when she arrived at the elementary school to load passengers for the afternoon route, he noticed nothing unusual in her mood or behavior.

The school busdriver's husband said that on Tuesday, the day before the accident, he and his wife had performed their usual morning activities. He drove their own children to school and then met his wife in the parking lot after she had completed her morning bus route. She returned the school bus to the storage lot, and the two of them went out for breakfast. They returned to their apartment and watched television until lunch. After lunch, the school busdriver reported to the high school for substitute teaching and then drove the afternoon route. She returned the school bus to the storage facility and went to her husband's place of business, arriving about 5:00 p.m. They ran personal errands and returned to their apartment for supper. They retired at the usual time, which was between 9:00 and 9:30 p.m.

On Monday, 2 days before the accident, the school busdriver did not work at the school between the morning and afternoon bus routes. She and her husband spent this time together at their apartment and at his place of business.

Certification and Training -- Before her employment with the Snyder School District, the school busdriver had obtained an Oklahoma Class B[5] commercial driver's license (CDL). She had no traffic violations on her record.

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[5]An Oklahoma Class B CDL permits the holder to operate "any single vehicle with a GVWR of 26,001 pounds or more and any one of those vehicles towing another vehicle with a GVWR of 10,000 pounds or less."

In August 1992, the school busdriver completed the 25-hour training course required for certification by the State of Oklahoma. Her driving test revealed no performance deficiencies. Before driving the school bus route, she also received 2 weeks of on-the-job training from the Snyder School District director of transportation, who was her supervisor. During the first week, she was required to drive a 65-passenger bus on several trips over the same route used for the driving test. During the second week, she transported students on several trips while accompanied by the director of transportation. He said that she performed well on all training tasks and on the driving test. When the accident occurred, she had been driving a Minotour on the school bus route for about 5 months.

Truckdriver Information

General -- The truckdriver, 28, said that he was in good physical health and that he did not smoke or use illegal drugs. He stated that his personal life was going very well. He said that he had been working 5- and 6-day weeks for Cornell on the Route 183 construction project and that he was paid by the hour. His CDL stipulated corrective lenses.

72-Hour History -- The truckdriver stated that he normally worked from 7:00 a.m. to about 5:00 p.m. and went to bed between 9:00 and 10:00 p.m. He said that for the 3 days before the accident, he did not deviate from this sleep and work routine, slept normally, took no medications, and consumed no alcoholic beverages.

On Wednesday, the day of the accident, the truckdriver left his house for work at 6:15 a.m. Cornell trip records show that his first load on the truck was weighed at 7:34 a.m. and that his last load was weighed at 3:12 p.m. He said that he ate in the truck as usual. He said that he often snacks in the truck but did not remember what he had eaten that day. He said that he was on his 17th and last trip of the day when the accident occurred. He said he was wearing corrective lenses at the time.

Work Experience and Driving Record -- He stated that his father, an experienced truckdriver, had taught him how to drive a truck. He said that he had purchased a tractor and hauled cattle before his employment with Cornell, which began in October 1992.

The truckdriver's traffic record in Oklahoma for the past 10 years showed 27 convictions for speeding and 6 convictions for other violations: operating an overweight vehicle, failing to stop for a red light, driving the wrong way on a one-way street, operating a motor vehicle without a current license plate, and driving while suspended (twice). His traffic record in Wyoming showed six speeding convictions that had been issued in Oklahoma, Texas, and Kansas

between January 1990 and October 1991. Between July 1990 and March 1992, Wyoming suspended his license twice and disqualified him, for serious offenses,[6] from driving a CMV. (See appendix C--Driver Information.)

Cornell's files on the truckdriver included a Motor Vehicle Certification of Violations. The only notation on the form was a $32 fine for one seatbelt violation in a passenger car in February 1993. The truckdriver had signed the form, thus certifying "that the following is a true and complete list of traffic violations (other than parking violations) for which I have been convicted or forfeited bond or collateral during the past 12 months." The form was dated October 1992, the month the truckdriver was hired.

On March 28, 1992, the truckdriver obtained a Texas CDL with a hazardous materials endorsement and an expiration date of April 19, 1996. However, Texas suspended the CDL on June 4, 1992, because of the truckdriver's CDL disqualification in Wyoming. On June 13, 1992, and July 1, 1992, the truckdriver committed speeding violations in Texas and Colorado, respectively. On July 30, 1992, Texas received clearance from Wyoming and reinstated the CDL. On September 28, 1993, about 6 weeks before the accident, Texas revoked the CDL because the truckdriver had been convicted within a 3-year period of two serious traffic violations while operating a commercial motor vehicle (CMV).

At the time of the accident, his Texas CDL was still revoked.[7] In addition, although he said that he had the medical certificate required for CMV drivers, he could not find it among his personal effects, and the Cornell office had no record of it. On November 22, 1993, 12 days after the accident and 66 days after Texas had revoked his license, the truckdriver paid a fine of $132. His license was reinstated.

Highway Information

The collision occurred on U.S. Route 183 (figure 6, top) at the intersection of County Line Road (figure 6, bottom), approximately 4 miles south of Snyder, Oklahoma.

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[6]According to the Commercial Motor Vehicle Safety Act passed by Congress on October 26, 1986, any speed exceeding the posted limit by 15 mph or more constitutes a serious violation for a CMV. The act stipulates that a commercial driver will lose his CDL "for at least 60 days if you have committed two serious traffic violations within a 3-year period involving a CMV."

[7]The Safety Board was unable to determine whether the driver was aware of the revocation, which was sent to his mother's home address in Texas. The truckdriver was living in Oklahoma at the time.

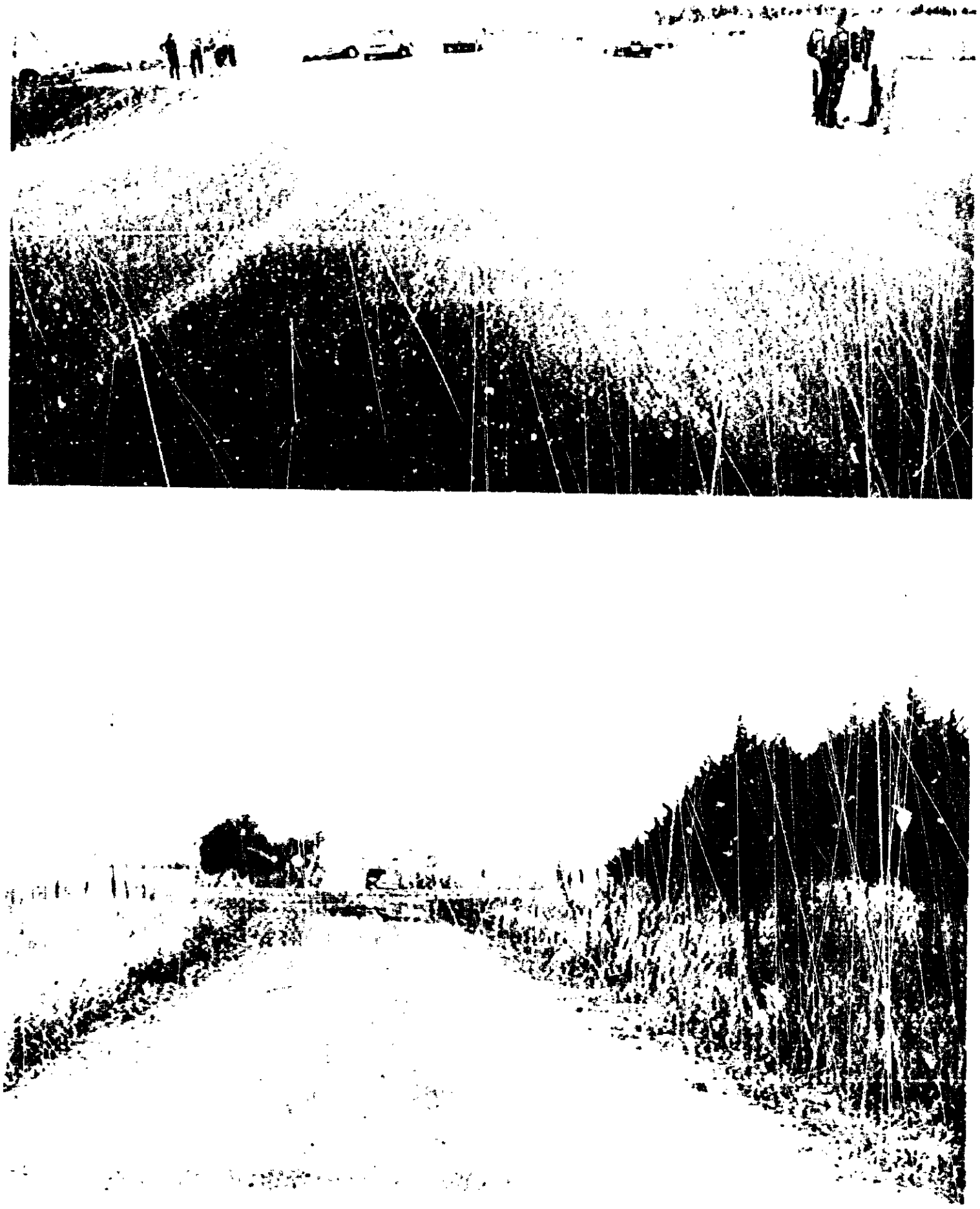

Figure 6. -- U.S. Route 183 (top) and County Line Road.

U.S Route 183 -- The highway runs north and south, and the posted speed limit is 55 mph. At the accident site, Route 183 is straight, level, 40 feet wide, two-lane, and two-way. The highway had been repaved on October 27, 1993; 14 days later, when the accident occurred, it had no lane markings except for intermittent strips of yellow tape representing a center line. In 1991, the average daily traffic count for this section of Route 183 was 1,400 vehicles.

County Line Road -- County Line Road is an east-west dirt roadway that perpendicularly intersects Route 183. The approaches to Route 183 (about 56 feet on the east and 47 feet on the west) are paved with asphalt. No speed limit signs are posted; therefore, the 55 mph State speed limit applies. At the time of the accident, an orange, diamond-shaped warning sign positioned more than 600 feet before the intersection with Route 183 read "Road Construction Ahead." Traffic on County Line Road is controlled by stop signs. The stop sign on the eastward approach to Route 183 is 32 feet from the intersection, and there is no stop line. For a driver approaching the intersection, the stop sign is visible from a distance of 600 feet. About 100 feet from the intersection, the view of the highway to the north is clear. The final 56-foot paved approach to the highway has a 2-percent downgrade decreasing to about 1 percent.

Work Zone -- When the accident occurred, a Federal-aid construction project was under way to grade, drain, and resurface 7.9 miles of Route 183 south of Snyder. This stretch of highway included the intersection with County Line Road. The southbound approach to the construction zone was marked with orange, diamond-shaped warning signs that read "Road Construction 1000 Feet" and "Speed Limit 45." The advisory speed plate was also a diamond-shaped orange sign with black lettering. It was on a tripod directly below the white rectangular sign with black lettering depicting the 55 mph speed limit. The Manual on Uniform Traffic Control Devices (MUTCD) states that:

> 2C-35. The Advisory Speed plate is intended for use to supplement warning signs. The standard size of the Advisory Speed plate shall be 18 x 18 inches. Advisory Speed plates used with 36-inch and larger warning signs shall be 24 x 24 inches.... It shall not be used in conjunction with any sign other than a warning sign, nor shall it be used alone. When used, it shall be mounted on the same assembly and normally below the standard warning sign.
>
> 6B-34. In conjunction with a warning sign, an Advisory Speed plate may be used to indicate a maximum recommended speed through a hazardous area.

The MUTCD depicts advisory speed plates for construction zone areas as square orange signs with "35 mph" in black lettering. No obstructions, detours, or pieces of equipment were in the work zone on the day of the accident. Although construction was under way about 7 miles south of the accident, no construction work was being performed on the northern approach to the accident site.

Postaccident Road Markings -- Safety Board investigators took measurements and photographs of the highway and the final resting positions of the vehicles. Dual tire marks began about 64 feet north of the tire scrub marks and gouges at the collision point. These dual tire marks continued past the collision point to the southwest corner of the intersection and ended near the final resting position of the tractor-semitrailer. Curved tire marks began at the collision point and continued to the southwest corner of the intersection in the direction of the final resting position of the school bus. (See figures 1 and 2.)

Operations Information

School District -- The school bus was owned by the Snyder School District. The district has 3 schools, 13 school buses (3 are small school buses), and 8 school busdrivers. The director of transportation for the Snyder School District hires, trains, and supervises the drivers. In addition, he performs basic maintenance on the school buses and some maintenance on the school buildings. Each school-day afternoon, he directs the movement of school buses from the elementary school parking lot onto the roadway. The buses then go to the middle[8] and high schools to pick up students there. After the buses leave the schools, the director of transportation stands by the CB radio base station to monitor drivers' calls and to provide assistance when needed. The director of transportation said that CB radios had been installed in the school district's buses earlier in the year. He noted that the school busdriver in this accident had requested the equipment following a mechanical breakdown on her route.

The school has eight daily bus routes, ranging in distance from 51 to 176 miles. The route assigned to the school busdriver in the accident served 20 children and covered 66 miles per day. The director of transportation stated that neither this driver nor her substitute driver had reported any discipline problems on the route. He said that school busdrivers are instructed to bring the bus to a stop in a safe location before dealing with major discipline problems. They are also instructed to assign problem students to front seats.

Student discipline is addressed in the Snyder School District's written policies on school transportation and in a guide, *School Bus Driver Manual,* published in 1992 by the Oklahoma State Department of Education. The school district complies with Department of Education minimum training requirements for school busdrivers. (See appendix F--Guidelines for Student Discipline on Snyder School Buses.)

Trucking Company -- Cornell is a private motor carrier that transports its own rock aggregates. Its primary business is highway construction, not transportation. The company has

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[8]The school busdriver involved in this accident did not pick up children at the middle school.

been in business since 1956, primarily performing highway construction projects in western Oklahoma. Cornell operates with 13 tractor-semitrailers and 4 straight trucks. It employs a varying number of workers, including two mechanics and one welder, who maintain company vehicles at a garage in Clinton, Oklahoma.

Cornell's vice president said that brakes on the company trucks are adjusted on an "as needed basis"; for example, they are adjusted if a driver makes a specific complaint. The vice president said that brake adjustments at specific mileage intervals are not required and that maintenance is usually delayed until completion of a construction project.

Maintenance records on the semitrailer in the accident showed that on May 18, 1993, the suspension system was repaired; on October 15, 1993, the brakeshoes were replaced on the right-rear brake, a wheel seal and brake kit were installed, and the brakes were adjusted. No other records were available for the semitrailer. Records for the tractor indicate that the wiring on the starter was repaired on June 11, 1993. The company vice president stated that much more maintenance had been performed on the tractor but had not been documented. He said he believes that on October 15, 1993, when the semitrailer's brakes were adjusted, the tractor's brakes were adjusted as well.

Medical and Pathological Information

The eight unrestrained children were ejected. The one restrained child remained in his seat. The school busdriver[9] was thrown into the lower part of the stepwell. Figure 7 shows the seating position of each passenger and describes the injuries each received, including the AIS[10] code for the most severe injury.

Four of the eight ejected children were fatally injured. Three were dead at the scene; the fourth sustained a critical head injury and died the following day. The injuries sustained by these four children included fractures, head injuries, multiple lacerations and abrasions, one almost-severed leg, and one chest penetration.

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[9]The director of transportation stated that on the day of the accident, the school busdriver was wearing her lap-shoulder restraint when she began her afternoon route.

[10]AIS refers to the Abbreviated Injury Scale of the Association for the Advancement of Automotive Medicine. The AIS is now a standardized, internationally accepted system of assessing the severity of impact injuries by coding each injury sustained by an individual. The first AIS was published in 1971 by a joint committee of the American Medical Association, the American Association of Automotive Medicine (now called the Association for the Advancement of Automotive Medicine), and the Society of Automotive Engineers. Injuries resulting from this accident have been coded according to the revised 1990 AIS.

Driver F-45* AIS-4**
Fractured r. humerus and r. ribs, with hemo/pneumothorax; contused liver and r. lung

Passenger #1 M-12 AIS-1
Contused r. humerus and r. femur

Passenger #2 M-5 AIS-1
Cerebral concussion; contused pelvis

Passenger #3 M-9 AIS-3
Fractured bilateral femur, r. humerus, and r. metatarsal

Passenger #4 F-5 AIS-3
Head injury; internal injuries; fractured bilateral clavicle and pelvis; abrasions

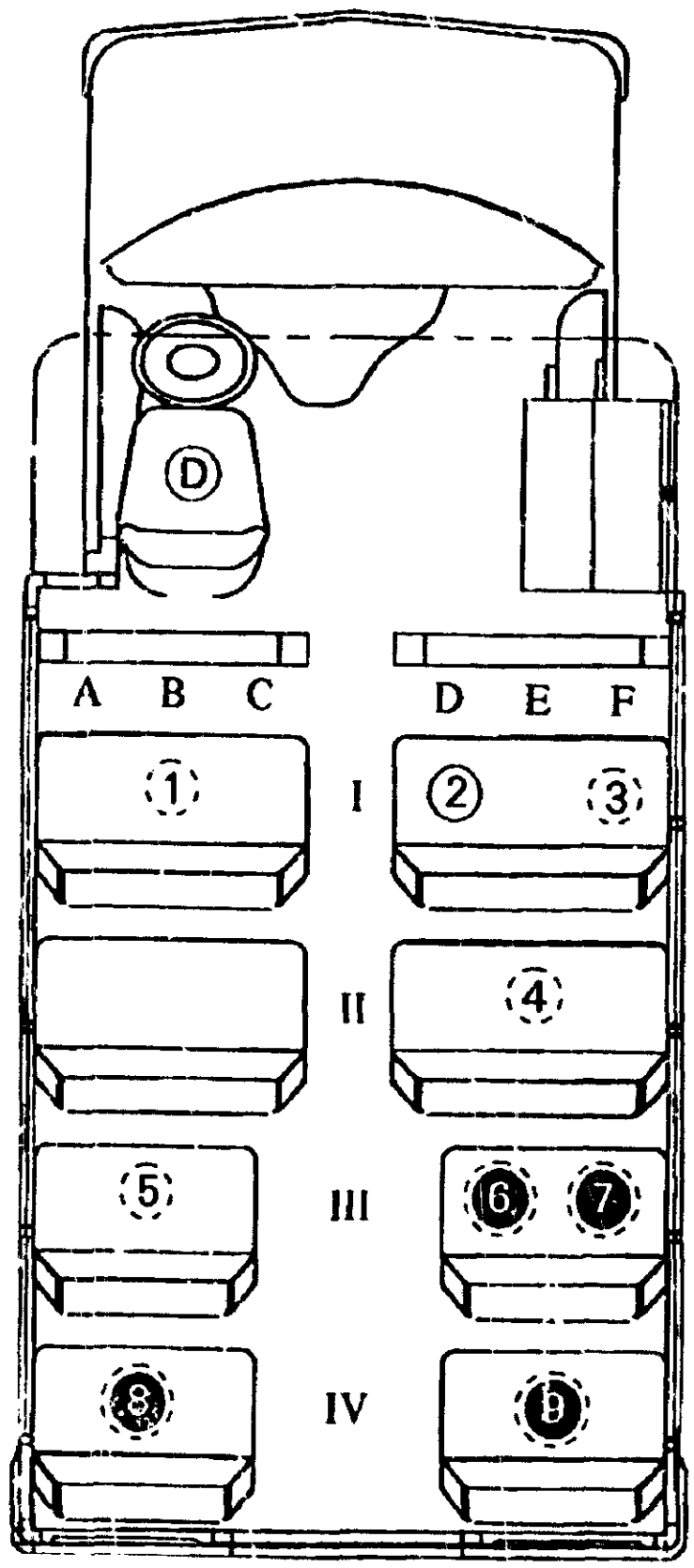
Passenger #5 F-12 AIS-2
Fractured pelvis

Passenger #6 M-9 AIS-3 Fatal
Fractured bilateral femur; multiple lacerations

Passenger #7 M-8 AIS-3 Fatal
Head injury; abrasions

Passenger #8 F-14 AIS-5 Fatal
Head injury; contused lung; liver and spleen lacerations; fractured r. clavicle and l. rib

Passenger #9 M-11 AIS-3 Fatal
Head injury; l. leg amputation; scalp laceration



LEGEND

AIS 0 = No injury
AIS 1 = Minor
AIS 2 = Moderate
AIS 3 = Serious
AIS 4 = Severe
AIS 5 = Critical
AIS 6 = Nonsurvivable
AIS 9 = Unknown

= Not ejected
= Ejected
= Fatal

* Indicates sex and age.
** Indicates highest AIS assigned to the individual's known injuries.

Figure 7. -- The occupants' injuries and their preimpact seating positions.

The four other children who were ejected survived. Their injuries, which ranged from minor to serious, included contusions, lacerations, and fractures. The child who was restrained sustained minor injuries--a cerebral concussion and a pelvic contusion.

The school busdriver's injuries were severe. The truckdriver received minor injuries. In response to a request from the Safety Board, toxicological tests were conducted on both drivers. The results were negative for alcohol and for the five drug groups[11] specified in 49 CFR Part 40

Survival Aspects

General -- A lapbelt was installed at each seating position on the bus, and the driver's seat was equipped with a lap-shoulder restraint. Only one of the nine children on the bus was wearing the available lapbelt.

The three children who died at the scene (passengers 6, 7, and 9) were seated in rows 3 and 4 on the right side of the bus, where the impact occurred. (See figure 10.) The fourth fatally injured child (passenger 8) was seated in the 4th row on the left side of the bus. She died the following day from an undefined head injury. The surgeon who treated her stated that he saw no indication of lapbelt usage. No autopsies were performed on these students, and the precise causes of death are unknown.

Passenger 5, who was sitting in the 3rd row on the left side of the bus, received moderate injuries. The most severely injured surviving child (passenger 4) was sitting in row 2 on the right side of the bus, near the impact area. The 5-year-old boy (passenger 2) who was restrained and was not ejected was sitting in the first row on the right side next to the aisle; he received minor injuries. The child sitting next to him in the window seat (passenger 3) sustained serious injuries. The 12-year-old boy that the school busdriver had moved to the seat directly behind her (passenger 1) received minor injuries. He believes that he was ejected through the right-front entrance door, which had opened during the impact.

The school busdriver, who was severely injured, stated that she had been wearing her lap-shoulder restraint. She explained that she wears it loosely. She said that when the impact occurred, her hand struck the restraint's release mechanism. She described "bouncing" out of her seat, striking the steering wheel with her chest, striking the door-control lever with her head, and falling into the stepwell in front of the opened entrance doors. The 12-year-old boy behind her stated that the driver was not wearing her restraint when the accident occurred.

The truckdriver, who received minor injuries, stated that he was wearing his lapbelt at the time of the collision.

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[11]Marijuana metabolites, cocaine metabolites, opiate metabolites, phencyclidine, amphetamines.

Lapbelt Practice -- As required by 49 CFR 571.208 S4.4.3.3, the 20-passenger school bus was equipped with lapbelts. However, no Federal regulation mandates the *use* of lapbelts. In addition, no law, regulation, or policy of the State of Oklahoma, the Oklahoma Board of Education, or the Snyder School District requires passengers on school buses to use the available lapbelts, although both State law[12] and school policy require school busdrivers to wear the lap-shoulder restraint. The school busdriver in this accident told Safety Board investigators that she usually made children in kindergarten through third grade (ages 5-8) wear their lapbelts. She explained that she could maintain better order on the bus if the smaller children stayed in their seats.

School Bus View Obstruction

Background -- The Snyder School District director of transportation said that the school busdriver had complained of a "blind spot" in the Minotour about a month before the accident. The school busdriver stated that she noticed the blind spot shortly after school started (September 1993). She said that when she was stopped at stop signs in town, she sometimes would not see any traffic coming; however, when she began to pull out, she would see a car coming down the road that had been obscured by the vertical support structure. The director of transportation told her to adjust to the view obstruction. She said that her method was to stop at the intersection, look, pull closer to the intersection, stop again, and look again. The school busdriver said that on the day of the accident, she never saw the tractor-semitrailer even though she had looked just before moving into the intersection.

Simulation Tests at Accident Site -- Safety Board investigators conducted tests at the accident site to determine whether the Minotour's right-side vertical support post could have obstructed the school busdriver's view of the southbound truck. In design geometry, the test school bus was identical to the Minotour in the accident. For the other vehicle, Board investigators used the semitrailer actually involved in the accident and a similar tractor. In the test school bus, a driver 5 feet 7 inches tall (the approximate height of the school busdriver) adjusted the driver's seat, and the investigators positioned the camera lens to replicate the position of the school busdriver's right eye. The tests were conducted at a time of day that would best replicate the position of the sun on the day of the accident. During each test, the sun was to the left front of the school busdriver, and it did not create a glare or impair vision.

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[12]Section 514 of the Oklahoma Motor Vehicle Code states: "The driver of every vehicle used by a school district for the transportation of school children shall make use of such seat belts while in operation of the vehicle...."

Still Photographs.--The test school bus was placed on County Line Road with the front bumper 10 feet from the east edge of Route 183.[13] The tractor-semitrailer was placed in the southbound lane of Route 183 about 564 feet north of the point of impact, or 7 seconds before impact.[14] On still photographs taken from the school busdriver's right-eye position, the truck is fully visible through the glass of the right-front entrance door (figure 8a). However, at 403 feet (5 seconds) from impact, the tractor-semitrailer is almost entirely obscured from view (figure 8c) and is entirely obscured until it is placed 161.2 feet (2 seconds) from impact (figure 8f).

These stationary view obstruction tests were repeated with the front bumper of the bus placed 30 feet from the east edge of Route 183, adjacent to the stop sign. At 7 seconds from the point of impact, the truck is visible. At 6 seconds from impact, the truck is almost obscured. It is entirely obscured until it is 2 seconds from impact.

Videotape.--The path of the approaching truck, which was being driven at a constant speed of 55 mph, was videotaped from the test school bus at 10 feet from the highway's east edge and again at 30 feet (adjacent to the stop sign). In both test cases, the truck is obscured on the videotape while it is 7 seconds through 3 seconds from impact. About 2 seconds from impact, the truck is visible.

Angle of View Obstruction -- Portions of the interior of the test bus were measured and re-created on scale diagrams to assess the angle of view obstruction from the school busdriver's seated position (figure 9). The vertical support structure obstructs the driver's view to the right through the window forward of the structure and through the window of the folding door rearward of the structure. This obstruction, when measured perpendicular to the driver's line of sight at a point 56 inches from the calculated position of the school busdriver's right eye, is 8 1/2 inches wide and creates a blind spot between 75 and 83.5 degrees. Calculations indicate that if the bus was stopped about 10 feet from the road edge, the approaching tractor-semitrailer would be obscured for about 4 seconds.

School Bus Design -- This type of small school bus consists of a modified school bus body on a small truck chassis. Small buses are an economical option for school systems that transport small groups of children on different routes. The 8 1/2-inch vertical post structure supports the body where it extends outward from the chassis and serves as the door hinge. Larger school buses have a similar design, but the driver seat is positioned about 6 inches farther back from the vertical post, giving the driver a wider angle of vision.

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[13]The American Association of State Highway Transportation Officials (AASHTO) states in a 1984 publication, *A Policy on Geometric Design of Highways and Streets*, that where no stop line exists on a roadway, it is assumed that a vehicle will come to a stop 10 feet from the edge of the intersecting roadway before proceeding into the intersection.

[14]Calculations of seconds before impact are based on an assumed truck speed of 55 mph and 80.6 feet per second.

Figure 8a. -- Seven seconds (564 feet) from impact.

Figure 8b. -- Six seconds (484 feet) from impact.

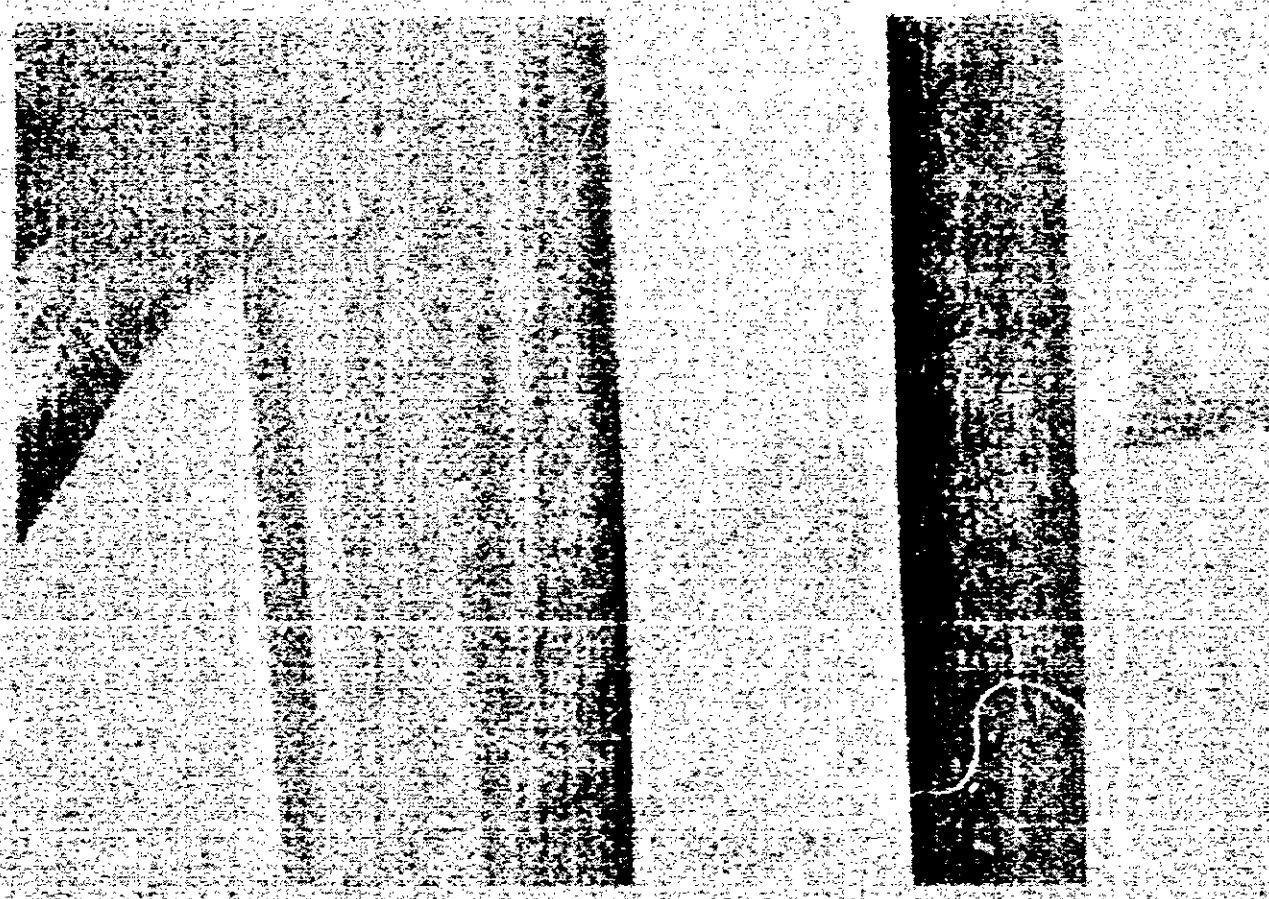

Figure [illegible] five seconds (403 feet) from impact.

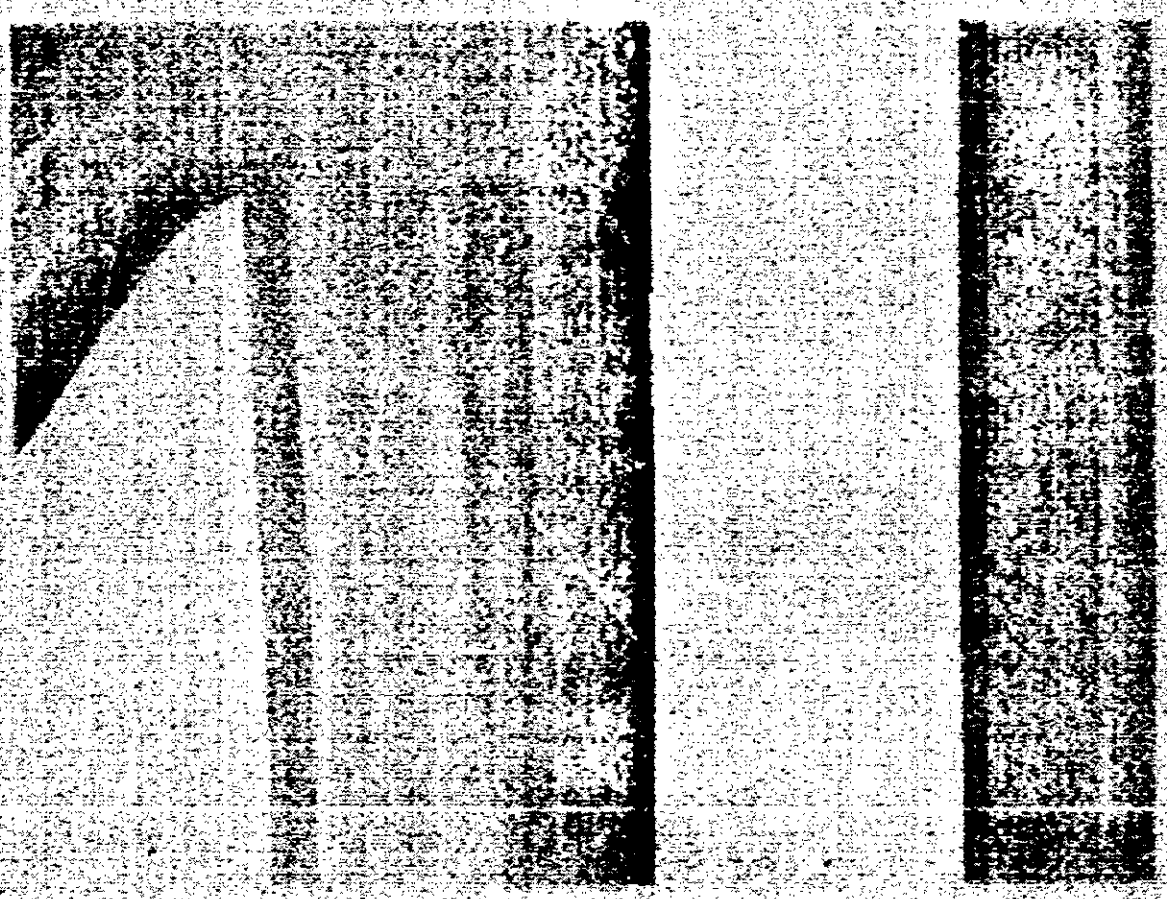

Figure [illegible] four seconds (322 feet) from impact.

Figure 8e. -- Three seconds (242 feet) from impact.

Figure 8f. -- Two seconds (161 feet) from impact.

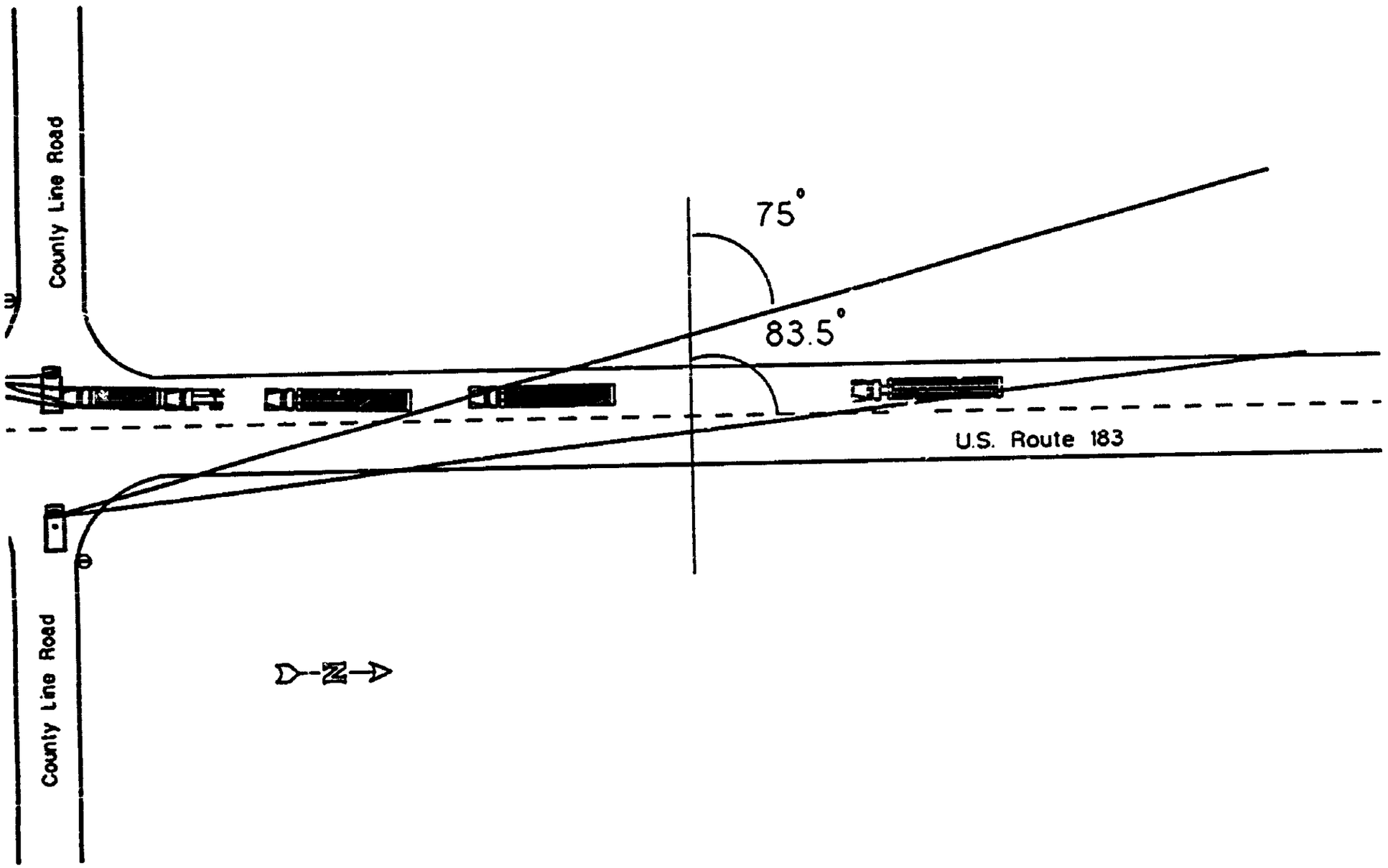

Figure 9. -- Line-of-sight obstruction at 10 feet from the intersection with the bus stationary. These conditions do not assess the effect of a moving bus.

Motor Carrier Oversight

State -- In 1986, Oklahoma adopted most of the Federal Motor Carrier Safety Regulations[15] (FMCSR) in Oklahoma statute Title 47, Section 230.5. In May 1992, officers from the Oklahoma Motor Carrier Safety Assistance Program (MCSAP) conducted a safety review of Cornell and placed several of the carrier's vehicles out-of-service. According to Cornell officials, their vehicles had not been involved in any accidents during the year preceding November 10, 1993. Nonetheless, between September 1989 and September 1993, MCSAP personnel conducted 33 roadside inspections of Cornell vehicles and found 167 driver and vehicle violations. Two of these roadside inspections--one in March 1993 and one in April 1993--involved the truckdriver in the accident. MCSAP records show that he was cited for the following violations:

March 1993 Roadside Inspection	April 1993 Roadside Inspection
No driver inspection report. Fire extinguisher needs recharging. Inoperative right-turn signal lamp. No medical certificate. Three adjacent lug nuts loose (axle 3, right side). Hole in left stop-lamp lens.	Speeding 72 mph in a 55-mph zone. No medical certificate. Not wearing a seatbelt. No post-trip inspection. Weather-cracked brake hoses (axle 1, left and right sides). Horizontal movement between upper and lower fifth wheel. Brake pushrod exceeds maximum stroke (axle 1, left side). One of 10 nuts loose (axle 3, left side). Chafing of brake tubing at pogo stick. No emergency warning devices. Loose fuel caps on left- and right-side tanks. Inoperative side marker lamps (left and right sides, rear).

[15]These regulations are found in 49 CFR Parts 390-397 and include regulations pertaining to Qualifications of Drivers, Driving of Motor Vehicles, Parts and Accessories Necessary for Safe Operation, Hours of Service of Drivers, Inspection, Repair and Maintenance, and Transportation of Hazardous Materials.

Two days after the accident, MCSAP personnel began a compliance review of Cornell; the review was completed on November 24, 1993. MCSAP found 21 violations, made 26 recommendations, and fined the carrier $5,000. At an administrative hearing on October 11, 1994, the State of Oklahoma and Cornell entered into a settlement agreement, and on October 25, 1994, Cornell paid a fine of $3,500.

Federal -- The Federal Highway Administration (FHWA) keeps track of carriers under its jurisdiction on an automated system called the Motor Carrier Management Information System (MCMIS). Each carrier entered in the MCMIS is assigned a USDOT (U.S. Department of Transportation) number. On each side of each truck, the carrier is required to display the company name, the USDOT or the Interstate Commerce Commission number, and the city and State of its principal office or terminal.

The truck in this accident carried no USDOT number, and Cornell had represented itself as an intrastate carrier. After the accident, however, Federal and State investigators discovered that the carrier was also conducting interstate operations, including the transportation of hazardous materials, and was therefore subject to Federal regulation. On November 22, 1993, 12 days after the accident, the FHWA added Cornell to the MCMIS. The FHWA then conducted a review and determined that Cornell was operating at an unacceptable level of compliance with the FMCSR and Hazardous Materials Regulations.

On March 15, 1994, the FHWA issued Cornell an unsatisfactory rating, citing deficiencies in the qualifications of drivers, in the hours of service for drivers, in recordable/preventable accident rates, and in the safe transportation of hazardous materials. The FHWA informed Cornell by letter that it was prohibited (1) from transporting placardable quantities of hazardous materials and (2) from transporting for hire more than 15 passengers, including the driver, in interstate commerce. The letter also stated: "Immediate action must be taken to correct any deficiencies or violations discovered during the compliance review."

ANALYSIS

The Safety Board determines that neither the weather nor the highway conditions, including the work zone, contributed to the accident. Toxicological tests showed that neither driver was impaired by alcohol or other drugs. Both drivers had been on a normal working schedule and had slept at least 8 hours the night before the accident. The postaccident mechanical inspection revealed no preimpact mechanical deficiencies in the school bus. No problems or delays hampered the emergency response to treat and transport the injured.

The Safety Board identified the following safety issues:

(1) The protection provided school bus occupants.

(2) The performance of the school busdriver and the view obstruction in the school bus.

(3) The performance of the truckdriver.

(4) The adequacy of motor carrier oversight.

The Accident

Sequence of Events -- Based on the physical evidence (including paint transfers, vehicle damage, tire marks, and other markings at the accident site), the Safety Board believes that the following sequence of events tock place. The truckdriver swerved to the right, applied the brakes, and skidded 40 feet before striking the right side of the bus at an angle 3 degrees to the right of perpendicular. The impact caused the school bus to suddenly move southward and to rotate clockwise. A secondary impact, which occurred between the right front of the school bus and the right side of the tractor, slowed the clockwise rotation of the bus. The two vehicles separated, and both continued moving southward. The bus left the paved roadway and entered the dirt shoulder. The bottom right-rear corner of the bus dug into the ground, and the vehicle lost considerable momentum. The bus tilted toward its right side, traveled down the dirt embankment, and came to rest in an upright position facing northeast, 90 feet from the point of impact. The tractor-semitrailer traveled another 250 feet on the right shoulder and overturned onto its right side.

Speed and Impact Force Estimates -- The Safety Board attempted to determine the vehicle speeds and impact forces involved in this accident. Investigators used a variety of engineering and forensic analytical methods; however, the results were inconsistent. For

example, based on the 40 feet of preimpact truck tire marks, the 250 feet the truck traveled after impact, and a maximum drag factor of 0.33,[16] the Safety Board calculated[17] that the truck was traveling between 52 and 61 mph before the accident and that the impact speed of the truck was between 48 and 55 mph. However, if the occupants had been subjected to the forces that an impact speed in this range would generate, their injuries would have been different and more of them might have been killed.

The Safety Board was able to estimate a maximum preimpact speed for the truck. The truckdriver stated that he was traveling between 55 and 60 mph and was in 12th gear. Calculations indicate that the normal speed range for 12th gear in the accident truck would have been between 55.5 and 64.9 mph. Based on this information and Safety Board calculations, the Board concludes that the preimpact speed of the truck was no more than 65 mph.

Because of such factors as the secondary impacts with the truck and with the ground, the overturn of the truck, and the significant difference in mass between the two vehicles, conventional methods for determining preimpact speeds could not be applied to the school bus in this accident. In addition, the rate of preimpact acceleration could not be determined. Based on (1) the distance (between 54 and 74 feet) that the school bus traveled upon entering the intersection to the point of impact and (2) an estimated average acceleration rate of 3.2 feet per second per second (fps/s),[18] the Safety Board calculated that the school bus was traveling between 12 and 16 mph when it was struck. However, this estimate is dependent on preimpact truck speed calculations.

Occupant Kinematics -- Based on the collision dynamics, the physical evidence, and the location of the ejected occupants, the Safety Board believes that the following occupant kinematics probably occurred.

The school bus was traveling west through the intersection. When the truck struck the right side of the school bus, its mass and speed caused the school bus to suddenly acquire momentum in a perpendicular direction--south. The unrestrained occupants of the school bus almost immediately collided with the truck, with the right-side interior of the school bus, or with each other. At that point, their momentum, like that of the bus, suddenly changed from

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[16]A normal coefficient of friction (drag factor) for this truck with properly adjusted brakes would have been about 0.6; however, because of the condition of the truck brakes--out of adjustment, cracked parts, contaminated with oil or asphalt--braking force calculations estimated the drag factor to be about 0.33.

[17]The computer program used was the Engineering Dynamics Simulation Model of Automobile Collisions (EDSMAC), Version 2, 1989.

[18]Research data indicate that an average acceleration rate for a 12,000 pound GVWR truck is 3.2 fps/s. See *Traffic Accident Reconstruction*, Fricke, Northwestern University Traffic Institute, 1990; and *Transportation and Traffic Engineering Handbook*, Institute of Transportation Engineers, Prentice-Hall, 1982.

westward to southward. Simultaneously, the bus began to rotate clockwise. The unrestrained students, who were now pressed against the right-side interior of the bus, also experienced this rotation. Centripetal force kept them pinned against the right side as the bus rotated while moving south. Some of the occupants might have been partly ejected at this point. The school bus separated from the truck, continued southward, and moved onto the dirt embankment. Its right rear dug into the ground, and the vehicle suddenly lost momentum. Most of the occupants were probably fully ejected at this point as a result of the loss of momentum, the rotational forces, or a combination of both. Five occupants (passengers 1, 3, 4, 7, and 8) were ejected and thrown clear of the bus. They were followed by three other occupants (passengers 5, 6, and 9), who were ejected close to the bus. The bus tilted toward its right side and either dragged or ran over these three occupants as it continued down the embankment.

Protection Provided School Bus Occupants

Lapbelt Use -- Safety Board investigators visually examined the lapbelts before removing them from the bus on November 19, 1993. In February 1994, the Safety Board further analyzed the lapbelts, including the driver's lap-shoulder restraint, using standard lapbelt analysis techniques[19]--materials science, fiber analysis, and studies of the witness marks resulting from the mechanical effects of lapbelts in accidents. The Board examined the lapbelts with the Nikon Stereozoom microscope, removed selected samples of foreign matter, and subjected the samples to x-ray energy spectroscopy.

The lapbelt taken from seat 1D showed positive indicators that confirmed its use during the accident; it clearly showed imprints and crushed fibers in the belt webbing, as well as latchplate and cinchplate imprinting. This belt, which was cut by the passerby to free the 5-year-old boy (passenger #2) in seat 1D, was used as a control during the testing. No other lapbelts showed evidence of use during the accident. Therefore, the Safety Board concludes that the eight children who were ejected were not wearing their lapbelts.

The school busdriver stated that she was wearing her lap-shoulder restraint loosely and that her hand struck the restraint's release mechanism during the accident. However, the restraint had no positive witness markings. Just before the collision, the school busdriver had turned around in her seat to scold the students, and she may have released her lap-shoulder restraint in order to do so. In addition, the student seated directly behind her said that she was not wearing the restraint. Based on this evidence and on the fact that she was ejected from her seat, the Safety Board concludes that the school busdriver was not wearing her lap-shoulder restraint when the accident occurred.

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[19]Society of Automotive Engineers Report 840396, *Diagnosis of Seat Belt Usage in Accidents*, 1984.

Outcome for the Occupants -- The school busdriver's head struck the windshield, and her body hit the dashboard and the door-opening mechanism. These impacts probably caused her fractured right ribs and internal injuries. The school busdriver was then thrown to the bottom of the stepwell area. If she had been restrained by the available lap-shoulder belt, she would not have been thrown out of her seat and her injuries probably would have been less severe.

Passenger 1 believes that he was ejected through the right-front entrance door. If so, his injuries were probably caused by contact with the door or interior bus components near the door. His injuries were minor, and after the accident, he was able to move around and assist other passengers until help arrived. This student was not in the impact area (figure 10). If he had been restrained, he would not have been ejected and might have sustained injuries similar to those of passenger 2.

Passenger 2, who also sustained minor injuries, was restrained by his lapbelt throughout the accident sequence. The lapbelt inflicted a bruise over his pelvic bone. His concussion may have been caused by contact with passenger 3 or by the dislodged seat cushion found on top of him. If he had not been restrained, he probably would have been ejected.

Passengers 3, 4, 7, and 8 were all found within 40 feet of the bus. These students sustained internal injuries, head injuries, and multiple fractures. Such injuries could have resulted from striking each other, the truck, the right inside sidewall and roof of the bus, components of the right-side windows, or the ground. Passenger 3, whose injuries were severe, was on the perimeter of the impact area. If he had been restrained, he would not have been ejected. He might have been injured by the lapbelt or by contact with passenger 2 or the right sidewall, but those injuries would probably have been less severe. Passenger 4 sustained serious injuries on her left side. If she had been restrained, she would not have been ejected. However, she was sitting on a three-passenger bench seat, and her exact position when the impact occurred is unknown. If she had been restrained in either the aisle or center seat, she probably would have received less severe injuries because she would not have been in the impact area. If she had been restrained in the window seat, she would have been in the impact area and could have been killed. Passenger 7, who died at the scene, was seated in the impact area near the window. Although a lapbelt would have prevented his ejection, it would probably not have prevented his fatal injuries. The truck intruded into the bus where he was sitting. Passenger 8, who died the following day from an undefined head wound, was not in the impact area. If she had been restrained, she would not have been ejected, and her chances for survival might have been better.

Passengers 5, 6, and 9 were probably dragged or run over by the bus. They were found about 5 feet from the right side of the bus. Unlike the other ejected occupants, these three passengers had massive external injuries; their bodies were covered with dirt, and dirt was embedded in their wounds. These wounds probably were not sustained inside the bus. The bus interior had little evidence of body contact, and the amount of blood (a small splattering near the right sidewall and roof area) was negligible. On the outside of the bus, however, blood, tissue, creasing, and surface marks on the top right-rear side indicated contact with at least one

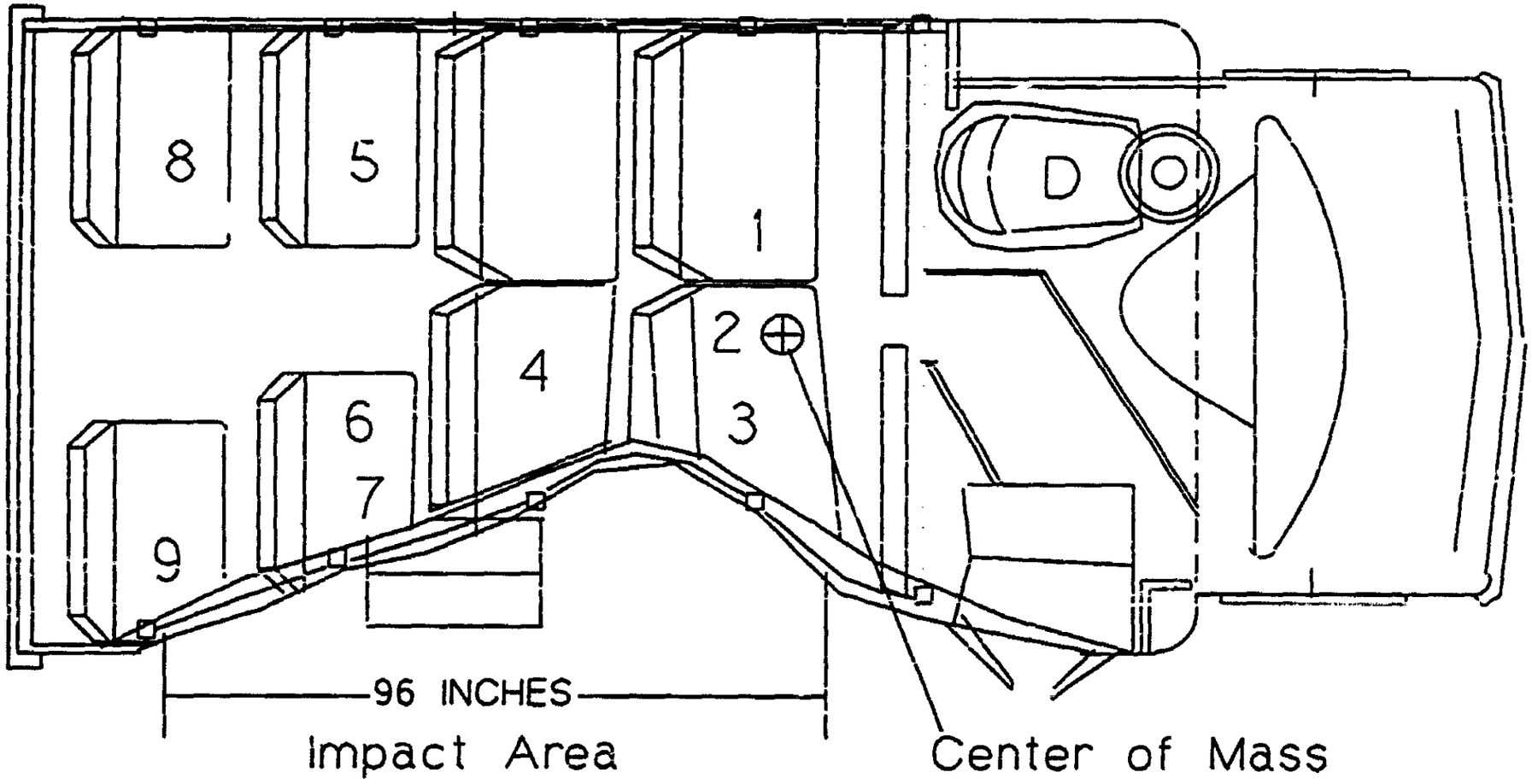

Figure 10. -- Collision Deformation — Impact Area.

occupant. Passenger 5, who survived, had a lacerated pelvic area and a fractured pelvic bone. She was not in the impact area, and if she had been restrained, she would not have been ejected and her injuries might have been less severe. Passengers 6 and 9 died at the scene. Passenger 6 had two fractured thigh bones, a penetrating injury to the chest, and multiple lacerations and abrasions. Passenger 9 sustained a severely lacerated scalp, multiple bruises, and his left leg was almost severed below the knee. Passengers 6 and 9 were both on the perimeter of the impact area. Lapbelts would have prevented their ejection. They might have been injured by the lapbelt, the sidewall of the bus, or contact with other passengers. However, they would not have received the massive external injuries that were inflicted during and after their ejection, and their chances for survival might have been better.

The Safety Board concludes that if the unrestrained passengers had been wearing the available lapbelts, none of them would have been ejected: Prospects for survival might have been better for three of the children who were killed (passengers 6, 8, and 9). Two of the children who survived (passengers 3 and 5) might have received less severe injuries. One seriously injured child who survived (passenger 4) might have been killed, depending on her position on the bench seat. For two children (passenger 1, who received minor injuries, and passenger 7, who was killed), the outcome probably would have been the same.

Lapbelts in Small School Buses -- On April 1, 1977, the National Highway Traffic Safety Administration (NHTSA) amended the Federal Motor Vehicle Safety Standards (FMVSS) to require that passenger seats in small post-1977 school buses (buses manufactured after April 1, 1977, with GVWRs of 10,000 pounds or less) be equipped with lapbelts. NHTSA *Highway Safety Program Guideline #17*, December 2, 1992, states:

> Passengers in school buses and school-chartered buses with a gross vehicle weight rating (GVWR) of 10,000 pounds or less should be required to wear occupant restraints (where provided) whenever the vehicle is in motion. Occupant restraints should comply with the requirements of FMVSS Nos. 208, 209, and 210, as they apply to multipurpose vehicles.

In 1983, based on several Safety Board school bus accident investigations, the Board concluded that although the overall safety record of school bus transportation in this country had been good, the protection of school bus passengers in crashes was still a matter of intense concern. On September 28, 1983, the Safety Board recommended that the Governors of the 50 States and the mayor of the District of Columbia:

> H-83-39
>
> Review State laws and regulations and take any necessary legislative action to ensure that passengers in small (more than 10 passengers and less than 10,000 GVWR) school buses and school vans are required to use available restraint

systems whenever the vehicle is in motion; ensure that all users of such vehicles are aware of and comply with these provisions.

According to the responses received, only six states (Louisiana, New Jersey, New Mexico, Virginia, Washington, and West Virginia) require the use of lapbelts on small school buses. The Snyder accident demonstrates that although lapbelts probably will not protect occupants in the impact area, the use of lapbelts may be beneficial to occupants outside the impact area or on its perimeter. Therefore, the Safety Board reiterates Safety Recommendation H-83-39 to all of the original recipients except the six States in compliance.

A 1989 safety study, *Crashworthiness of Small Poststandard School Buses,*[20] states:

> Accidents involving small school buses have been of interest to groups advocating the installation of passenger lapbelts on large school buses and to those concerned that the same types of lapbelt-induced injuries that have occurred in rear seats of passenger cars (National Transportation Safety Board 1986) would occur to lapbelted passengers in school buses.

As previously stated, the disparate size and mass of a small school bus compared with a large school bus means that findings about the advantages or disadvantages of passenger lapbelts on large school buses have little relevance to whether or not passenger lapbelts are needed on small school buses. For similar reasons, studies of the crash performance of lapbelts in the rear seat of a passenger car are not necessarily applicable to lapbelts in a small school bus. The differences in size and interior features between a passenger car and a school bus are too great.

The study concluded that:

> Small school buses generally provide good crash protection to both restrained and unrestrained passengers.
>
> Seating position is more important than restraint status in determining injury severity.

Safety officials, manufacturers, researchers, and advocates continue to disagree regarding the benefits of lapbelts in both large and small school buses. Crash test research suggests that in severe frontal school bus collisions, spinal and head injuries can result from the use of lapbelts. Nonetheless, neither NHTSA fatal accident reporting data nor Safety Board investigations have identified any accident in which a school bus fatality was due to a seatbelt-induced injury. Because the data regarding this controversy are inconclusive, the Safety Board will investigate school bus accidents involving restrained children and will focus on the

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[20] NTSB/SS-89/02.

occupant injury-kinematics correlation to determine whether lapbelts provide additional protection or cause injury.

Since the adoption in 1977 of Federal Motor Vehicle Safety Standard 222 regarding school bus passenger seating and crash protection, there has been a reduction in school bus occupant fatalities and injuries. However, the technological advances that have been made since 1977 in occupant protection (both passive and active) for passenger and commercial vehicles have not been broadly applied to school buses. Therefore, despite the outcome of the school bus lapbelt controversy, the Safety Board believes that NHTSA should evaluate occupant restraint systems, including those presently required, for small school buses. (Such systems could include 3-point lap-shoulder restraints and rear-facing seats.) Based on the results of this evaluation, NHTSA should require the installation of those systems that prove to be effective in reducing occupant deaths, injuries, and ejections. Also, the Safety Board believes that NHTSA, in cooperation with the National Association of State Directors of Pupil Transportation Service, should identify design or equipment modifications that will reduce the view obstructions in school buses. (Equipment modifications could include video cameras.)

School Busdriver's Performance -- View Obstruction

General -- The Safety Board attempted to determine why the school busdriver drove in front of the approaching tractor-semitrailer. She was operating a vehicle that had been regularly assigned to her since the beginning of the school year. She was familiar with the highways and secondary roads because she had driven the same route for about 12 months--during the previous school year and the first 3 months of the current school year. She was apparently concerned about safety; for example, the school district's director of transportation said that this school busdriver had recommended the installation of CB radios and had reported the view obstruction problem on the right side of the Minotour school bus. In disciplining the passengers just before the accident, she followed the procedures prescribed in the training course; she stopped at the stop sign and then reprimanded the children. The Safety Board's view obstruction tests determined that the sun would not have affected the school busdriver's vision at the intersection. In addition, there is no evidence that the school busdriver was impaired by loss of sleep or by the use of alcohol or other drugs.

Nonetheless, the school busdriver stated that she did not see the tractor-semitrailer when she started across Route 183. She said that she had looked twice for crossing traffic and that before entering the intersection, she had moved the school bus several feet forward to improve her view to the right. However, she did not see the approaching tractor-semitrailer and apparently entered the intersection because she believed the highway was clear of traffic.

View Obstruction -- The right-front vertical support structure of the school bus created a view obstruction 8 1/2 inches wide. Safety Board investigators calculated an angle of obstruction between 75 and 83.5 degrees. The positions of the school bus and truck relative to each other in distance and time are not known. However, in four tests--two at 10 feet from the highway edge and two at 30 feet--the tractor-semitrailer was obscured from view about 7 seconds from impact and remained obscured for 4 seconds.

The school busdriver told the Safety Board that she was aware of the view obstruction and had reported it to her supervisor. He told her to adjust to the view obstruction but offered no further guidance. The method she said she developed consisted of stopping at intersections, slowly moving forward, and stopping again. This technique would not circumvent the blind spot and would in fact prolong its duration because the occluded zone would move forward with the bus. Although the Safety Board's tests indicated a view obstruction of about 4 seconds in duration, these tests were conducted with a stationary school bus. Before the accident, however, the school bus, as well as the truck, was moving toward the point of impact, increasing the period of time that the truck was obstructed from the school busdriver's view. Therefore, the Safety Board concludes that because of the right-front vertical support structure, the approaching truck may have been obscured from the school busdriver's view for 5 to 7 seconds before the collision.

A similar accident investigation in Canada supports these findings. On June 8, 1994, in Sudbury, Ontario, a 65,000-pound Freightliner dump truck traveling 55 mph in a 60-mph zone, struck a 48-passenger Bluebird school bus that was crossing a 5-lane highway. Although the highway was straight and level and the weather was clear, the busdriver apparently did not see the truck. Transport Canada investigators conducted view-obstruction tests similar to those conducted by the Safety Board in the Snyder case. They found that with the bus in a stationary position, the truck would have been obscured from the school busdriver's view for 3 to 5 seconds.

Because the Snyder school busdriver's view of the tractor-semitrailer was obscured for several seconds before the collision, she would have had to exercise special precautions, such as moving her head forward and rearward several times, to ensure that she had an unobstructed view to the right. However, the director of transportation had provided her with no such instruction. Furthermore, neither the Oklahoma School Board of Education nor the National Association of State Directors of Pupil Transportation Service (NASDPTS) has offered any guidance to school busdrivers on how to overcome the problem. The Safety Board therefore believes that the NASDPTS should notify its members of the circumstances of this accident and develop effective driving strategies for overcoming the view obstructions inherent in school bus design. The Board believes that the NASDPTS should also cooperate with NHTSA to determine whether the view obstructions in school buses can be reduced through design or equipment modifications.

Unruly Students -- Safety Board investigators also considered the effect that the unruly student passengers might have had on the school busdriver's performance. Moments before the accident, she had interrupted her route to deal with the discipline problem. Investigators learned that she did not often need to reprimand the students on her route. In fact, the passengers recalled only one other scolding from this busdriver. Thus, even though she had precisely followed the disciplinary procedures prescribed in training, her reactions to the situation were probably not familiar. When she returned to her driving task, she may have been thinking about the earlier misbehavior of the children. She did not refasten her seatbelt, and she said that while entering the intersection, she looked up into the rearview mirror "to check on them." The Safety Board concludes that the school busdriver, during the brief interval between disciplining the children and resuming her route, may not have fully returned her attention to operating the vehicle.

Discipline Problems on School Buses -- The Safety Board has investigated several school bus accidents in which student behavior distracted the driver. For example, in the 1983 school bus accident in Miami, Florida,[21] the Safety Board determined: "Contributing to the accident was the busdriver's distraction from her driving duties by an unruly student passenger." In the 1984 school bus accident near Carrsville, Virginia,[22] the Board found: "The lack of student discipline on the bus was a problem, and the noise level in the bus may have interfered with the driver's ability to hear the whistle of the approaching train." In the 1985 school bus accident near Jefferson, North Carolina,[23] the Safety Board determined: "Contributing to the accident was the distraction of the driver by the unruly behavior of the student passengers." As a result of the Carrsville accident, the Safety Board recommended that NHTSA:

H-85-53

Encourage school jurisdictions in all States to emphasize the portions of the Highway Safety Program Standard (HSPS) 17, "Pupil Transportation Safety," and the program manual for HSPS 17 addressing the handling of student behavioral problems in training courses for school busdrivers and in instruction given students in the rules for bus riders, enforcement actions to be taken for rule violations, and the need for students to practice good behavior at all times while riding on a school bus.

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[21]Highway Accident Report--*School Bus Loss of Control Accidents in Miami, Florida, September 28, 1983, and Birmingham, Alabama, April 12, 1984* (NTSB/HAR-85/03).

[22]Highway Accident Report--*Collision of Isle of Wight County, Virginia, School Bus with Chesapeake and Ohio Railway Company Freight Train, State Route 615, near Carrsville, Virginia, April 12, 1984* (NTSB/HAR-85/02).

[23]Highway Accident Report--*School Bus Rollover, State Route 88, near Jefferson, North Carolina, March 13, 1985* (NTSB/HAR-85/05).

On April 18, 1986, NHTSA responded that it agreed with the Safety Board's recommendation and that it had asked State Pupil Transportation Safety Coordinators to comply, particularly in training school busdrivers and in instructing bus students about acceptable behavior. On July 1, 1986, the Safety Board classified the recommendation "Closed--Acceptable Action."

Truckdriver's Performance

The truckdriver, upon recognizing the hazard, took at least two actions to avoid the bus or to reduce the severity of the collision. Evidence at the scene confirmed his statement that he had swerved to the right and applied the brakes until impact. The Safety Board's time and distance analyses indicate that when the school bus moved into the intersection, the truckdriver had 2 seconds or less to recognize the school busdriver's intent and to select avoidance actions and carry them out. Truck tire skidmarks showed that the truckdriver had turned the tractor-semitrailer to the right about 3 degrees before impact. When the driver depressed the brake pedal, about 1/2 second was required to charge the airbrake system, and the road markings showed another 1/2 second of locked-wheel skidding before impact. The Safety Board concludes that the truckdriver did not have sufficient time to avoid the collision.

The Safety Board's accident reconstruction indicates that the tractor-semitrailer was traveling not more than 65 mph when the truckdriver recognized the hazard. A speed advisory of 45 mph was posted for the section of Route 183 under construction. The truckdriver said that he knew the location of all potentially hazardous construction activities and knew that the construction work had progressed well beyond County Line Road. The Safety Board concludes that if the truckdriver had been traveling at the 45 mph advisory speed, the impact forces would have been lower and the crash forces transmitted to the occupants would have been less severe.

Motor Carrier Oversight

State -- As part of this investigation, the Safety Board examined Oklahoma MCSAP records. These records showed that during the 4-year period preceding the accident, MCSAP personnel had conducted roadside inspections of Cornell's trucks, found numerous violations, issued citations, and levied fines. Cornell seemed unresponsive because violations previously identified were continually repeated. In addition, MCSAP regulations require the carrier to prepare and retain inspection and maintenance records for at least 14 months; the carrier had not complied.

After the accident, MCSAP personnel performed a 13-day compliance review of Cornell. MCSAP found 21 violations, made 26 recommendations, and fined the carrier $5,000. Cornell contested the fine, and it was reduced to $3,500. However, Cornell's vice president told Safety Board investigators that the brakes on Cornell trucks were adjusted on an "as needed" basis and that such work was often postponed until construction projects were completed. In addition, the carrier had very few maintenance records. The FMCSR stipulates:

> 49 CFR 396.3--Inspection, repair, and maintenance. Every motor carrier shall systematically inspect, repair, and maintain, or cause to be systematically inspected, repaired, and maintained, all motor vehicles subject to its control.
>
> 49 CFR 396.21--Periodic inspection recordkeeping requirements. The original or a copy of the inspection report shall be retained by the motor carrier or other entity who is responsible for the inspection for a period of fourteen months from the date of the inspection report. The original or a copy of the inspection report shall be retained where the vehicle is either housed or maintained. The original or a copy of the inspection report shall be available for inspection upon demand of an authorized Federal, State, or local official.

The Safety Board concludes that if the truck brakes had been properly adjusted, the impact forces would have been lower and the crash forces transmitted to the occupants would have been less severe. Furthermore, the Safety Board concludes that Cornell failed to systematically maintain the accident truck and to ensure that the truckdriver had a valid CDL. The Safety Board believes that Cornell should establish a systematic vehicle-maintenance and driver-oversight program that complies with Federal or State Motor Carrier Safety Regulations.

MCSAP personnel explained that the number of citations issued to Cornell is about average for carriers of the same size in Oklahoma. They also explained that the Oklahoma Department of Public Safety has no authority to place motor carriers out-of-service even after repeated instances of noncompliance with safety regulations. The Board's investigation indicates that roadside inspections, citations, and fines are not sufficient to make motor carriers in Oklahoma comply with safety regulations. The Safety Board therefore believes that the Governors of the 50 States and the mayor of the District of Columbia should provide the appropriate State agencies with the authority to place a motor carrier out-of-service if a pattern of noncompliance is established.

Federal -- The FHWA did not identify Cornell as an interstate carrier until after the accident. In its 1993 report on an intercity bus accident,[24] the Safety Board extensively addressed Federal oversight of motor carriers and concluded that the FHWA system for identifying carriers is inadequate. As a result of that investigation, the Board asked that the FHWA:

> H-93-28
> Develop a systematic and continual process of identification of carriers subject to the Federal Highway Administration's jurisdiction that includes the immediate entry of new carriers onto the Motor Carrier Management Information System, systematically accessing available State record systems, and maintaining contact with the Interstate Commerce Commission concerning new motor carriers. Devise a method of verifying that the process results in the identification of the entire carrier population.

The FHWA responded on November 3, 1993, that Office of Motor Carriers field personnel often identify new carriers through various resources, including State records, and that since the 1992 accident, they had been implementing carrier identification programs to comply with this recommendation. FHWA could have identified Cornell by accessing many information sources, such as motor vehicle records, road-use tax records of the Public Utility Commission, and State MCSAP records. Nonetheless, when the Snyder accident occurred, the FHWA still had not identified Cornell either as an interstate carrier or as a hazardous materials carrier. Therefore, Safety Recommendation H-93-28 is classified "Open--Unacceptable Response."

As a result of its investigation of the Brinkley, Arkansas, accident,[25] which involved the failure of an intercity busdriver and an interstate truckdriver to report license suspensions and moving traffic violations, the Safety Board asked that the FHWA:

> H-87-45
>
> Revise the Federal Motor Carrier Safety Regulations without delay to require operators of commercial motor vehicles to periodically obtain and retain on file the driving violation conviction record for each driver employed from the State which issued the driver's license to operate a commercial vehicle.

In its August 25, 1989, letter to the Board, the FHWA stated that Federal Motor Carrier Safety Regulation 49 CFR 391.25 satisfies the Safety Board's recommendation. This regulation relies on commercial drivers to report their violations to their employers; it does not require the

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[24]Highway Accident Report--*Charter Bus Loss of Control, Overturn, and Fire, Vernon, New Jersey, July 26, 1992* (NTSB/HAR-93/02).

[25]Highway Accident Report--*Trailways Lines, Inc., Intercity Bus Collision with Rising Fast Trucking Company, Inc., Interstate Highway 40 near Brinkley, Arkansas, July 14, 1986* (NTSB/HAR-87/05).

carrier to check the license status with the licensing agencies. Therefore, in December 1989, the Safety Board classified this recommendation "Closed--Unacceptable Action."

The truckdriver involved in the Snyder case provided a Texas CDL when he was hired by Cornell in October 1992. His license status in Texas was clear at that time. However, if Cornell personnel had requested his traffic records from Oklahoma or Wyoming, they would have found an extensive list of violations, including 33 speeding convictions in 4 States during the past 10 years. The truckdriver knew about his record, but on his statement to Cornell, he reported only one incident--a seatbelt violation in a passenger car.

Thus, this accident demonstrates again the unreliability of a self-reporting system for drivers. A driver who has accumulated numerous violations or suspensions is unlikely to risk loss of employment by reporting them to a carrier. Sections 11 and 27 of Federal Motor Carrier Safety Regulation 49 CFR 391 require the driver to furnish the motor carrier with a list of violations, but they do not require the carrier to check the driver's official records. The Safety Board therefore believes that the FHWA should immediately revise the Federal Motor Carrier Safety Regulations to require that motor carriers check a driver's record, both initially and at least annually, with State licensing agencies where the driver works and is licensed.

Furthermore, since this problem involves intrastate carriers as well, the Safety Board believes that the Governors of the 50 States and the mayor of the District of Columbia should require that motor carriers check a driver's record, both initially and at least annually, with State licensing agencies where the driver works and is licensed.

CONCLUSIONS

1. Neither the weather nor the highway conditions, including the work zone, contributed to the accident; neither driver was impaired by drugs or fatigue; the school bus had no preimpact mechanical deficiencies; and no problems or delays hampered the emergency response to treat and transport the injured.

2. The school busdriver, during the brief interval between disciplining the children and resuming her route, may not have fully returned her attention to operating the vehicle.

3. Because of the right-front vertical support structure, the approaching truck may have been obscured from the school busdriver's view for 5 to 7 seconds before the collision.

4. The preimpact speed of the truck was no more than 65 mph.

5. The truckdriver did not have sufficient time to avoid the collision.

6. If the truckdriver had been traveling at the 45 mph advisory speed, the impact forces would have been lower and the crash forces transmitted to the occupants would have been less severe.

7. If the truck brakes had been properly adjusted, the impact forces would have been lower and the crash forces transmitted to the occupants would have been less severe.

8. Cornell Construction Company failed to systematically maintain the accident truck and to ensure that the truckdriver possessed a valid license to operate a commercial vehicle.

9. When the accident occurred, the eight children who were ejected were not wearing their lapbelts and the school busdriver was not wearing her lap-shoulder restraint.

10. If the unrestrained passengers had been wearing the available lapbelts, none of them would have been ejected: Prospects for survival might have been better for three of the children who were killed. Two of the children who survived might have received less severe injuries. One seriously injured child who survived might have been killed, depending on her position on the bench seat. For two children who received minor injuries and one child who was killed, the outcome probably would have been the same.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the accident was that the school busdriver did not see the approaching truck because her view was obstructed, because she had not been provided with an effective strategy or other means for overcoming the view obstruction, and because she may have been distracted by the unruly passengers. Contributing to the severity of the accident were the truckdriver's failure to observe the speed advisory and the failure of Cornell Construction Company to systematically maintain the accident truck.

RECOMMENDATIONS

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

--to the National Highway Traffic Safety Administration:

Evaluate occupant restraint systems, including those presently required, for small school buses. Based on the results of this evaluation, require the installation of those systems that prove to be effective in reducing occupant deaths, injuries, and ejections. (Class II, Priority Action) (H-94-10)

In cooperation with the National Association of State Directors of Pupil Transportation Service, identify design or equipment modifications that will reduce the view obstructions in school buses. (Class II, Priority Action) (H-94-11)

--to the Federal Highway Administration:

Immediately revise the Federal Motor Carrier Safety Regulations to require that motor carriers check a driver's record, both initially and at least annually, with State licensing agencies where the driver works and is licensed. (Class II, Priority Action) (H-94-12)

--to the Governors of the 50 States and the mayor of the District of Columbia:

Provide the appropriate State agencies with the authority to place a motor carrier out-of-service if a pattern of noncompliance is established. (Class II, Priority Action) (H-94-13)

Require that motor carriers check a driver's record, both initially and at least annually, with State licensing agencies where the driver works and is licensed. (Class II, Priority Action) (H-94-14)

--to the National Association of State Directors of Pupil Transportation Service:

Notify your members of the circumstances of this accident and develop effective driving strategies for overcoming the view obstructions inherent in school bus design. (Class II, Priority Action) (H-94-15)

Cooperate with the National Highway Traffic Safety Administration to determine whether the view obstructions in school buses can be reduced through design or equipment modifications. (Class II, Priority Action) (H-94-16)

--to the Cornell Construction Company, Inc.

Establish a systematic vehicle-maintenance and driver-oversight program that complies with Federal or State Motor Carrier Safety Regulations. (Class II, Priority Action) (H-94-17)

In addition, the National Transportation Safety Board reiterates the following recommendation, originally issued on September 28, 1983, to the Governors of the 50 States (except Louisiana, New Jersey, New Mexico, Virginia, Washington, and West Virginia) and to the mayor of the District of Columbia:

H-83-39

Review State laws and regulations and take any necessary legislative action to ensure that passengers in small (more than 10 passengers and less than 10,000 GVWR) school buses and school vans are required to use available restraint systems whenever the vehicle is in motion; ensure that all users of such vehicles are aware of and comply with these provisions.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JAMES E. HALL
Chairman

JOHN K. LAUBER
Member

JOHN A. HAMMERSCHMIDT
Member

November 29, 1994

APPENDIXES

APPENDIX A

INVESTIGATION AND HEARING

Investigation

On November 11, 1993, about 7 a.m., the Safety Board dispatched an investigative team with members from Washington, D.C., and Arlington, Texas. Groups were established to pursue the human performance aspects; the highway, vehicle, and survival factors; and motor carrier operations.

Representatives of the Federal Highway Administration, the National Highway Traffic Safety Administration, the Oklahoma Highway Patrol, Oklahoma State Department of Education, Thomas Built Buses, Inc., and Beam's Industries, Inc., participated in the investigation.

Public Hearing—Depositions

No public hearing was held, and no depositions were taken during the investigation.

APPENDIX B

AIS INJURY TABLE

Injuries		Drivers	Passengers	Total
AIS-1	Minor	1	2	3
AIS-2	Moderate	0	1	1
AIS-3	Serious	0	5	5
AIS-4	Severe	1	0	1
AIS-5	Critical	0	1	1
AIS-6	Nonsurvivable	0	0	0
AIS-9	Unknown	0	0	0
Totals		**2**	**9**	**11**

APPENDIX C

DRIVER INFORMATION

SCHOOL BUSDRIVER

JoAnn McCorkle was 45 years old. She was married and had one child. She had an Oklahoma commercial driver's license with an endorsement for light trucks or buses; the expiration date was March 31, 1996. She had no traffic violations on her record. She was hired by the Snyder School District to drive school buses.

TRUCKDRIVER

James Brent Belding was 28 years old. He was married and had one child. On September 1, 1992, he had obtained a Texas commercial driver's license with a hazardous materials endorsement; the expiration date was April 19, 1996. In October 1992, he was hired to drive for Cornell Construction Company, Inc., in October 1992. On September 28, 1993, the truckdriver's license was revoked. His driving record is as follows:

Date	State	Incident
12-3-82	Oklahoma	Speeding
12-14-84	Oklahoma	Speeding
8-20-85	Oklahoma	Speeding
9-25-85	Oklahoma	Speeding
11-5-85	Oklahoma	Overweight violation
5-19-86	Oklahoma	Speeding
8-23-86	Oklahoma	Speeding
10-27-86	Oklahoma	Speeding
3-2-87	Oklahoma	Operating w/o current license plate
3-11-87	Oklahoma	Speeding
5-9-87	Oklahoma	Speeding
5-15-87	Oklahoma	Speeding
5-22-87	Oklahoma	Failure to stop for red light
10-27-87	Oklahoma	Speeding

APPENDIX D

DIFFERENCES IN FEDERAL MOTOR VEHICLE SAFETY STANDARDS FOR SMALL AND LARGE SCHOOL BUSES

The following information is from a National Transportation Safety Board Safety Study, *Crashworthiness of Small Poststandard School Buses*, NTSB/SS-89/02, pages 14 and 15:

Federal Motor Vehicle Safety Standards (FMVSS) specify for school buses with a GVWR of 10,000 pounds or less different performance standards and, in some respects, less stringent standards than those required for larger school buses. Type A school buses are the only type of school bus considered "small" or "light" school buses by FMVSS. NHTSA proposed a "combination of requirements for light school buses that differ from those for heavier buses because the crash pulse experienced by smaller vehicles is more severe than that of larger vehicles in similar collisions" (41 FR 4016, January 28, 1976). Three of the most substantial differences between Type A school buses and other types of school buses are outlined below.

Lapbelts

Type A school buses, like all passenger cars and multipurpose vans, are required by FMVSS to be manufactured with at least a lapbelt at every occupant seating position. In the preamble to Federal Motor Vehicle Safety Standard 222, *School Bus Seating and Crash Protection*, NHTSA stated that "such restraints are necessary to provide crash protection in small vehicles" (41 FR 4016, January 28, 1976). Other types of school buses (Types B, C, and D) are not required by FMVSS to have passenger lapbelts installed, and if . . . [seatbelts are installed], they need not meet Federal seatbelt standards.

APPENDIX D

Vehicle Structure

Type A school buses are not required by FMVSS to have the same level of structural integrity as larger school buses. They are exempt from the Federal standards that specify joint strength, and a less stringent test of roof strength is applied. In 1973, during rulemaking connected with Federal Motor Vehicle Safety Standard 221, *School Bus Body Joint Strength*, NHTSA found "no evidence that the mode of [joint] failure found in larger traditional school buses also occurs in smaller van-type school buses currently manufactured . . . for use as 11- to 17-passenger school buses . . . Until information to the contrary appears or is developed, these vehicles should not be covered by the requirement [41 FR 3872, January 27, 1976] . . . ."

Seating

Seating standards are also different for Type A school buses than for other school buses: compartmentalization is incomplete. When Federal rulemaking regarding school bus seating was first proposed, the seats of all school buses were required to meet identical requirements in terms of seat spacing and seat performance. Several commenters objected to the applicability of the standard to school buses with a GVWR of 10,000 pounds or less, asserting that the special requirements of the standard for small school buses were inappropriate, or unachievable, within the 9-month lead time for compliance mandated by Congress. Since NHTSA had specified "adequate numbers of seatbelts for the children that the vehicle would carry," different requirements for seating in small school buses were considered "reasonable," and NHTSA exempted seats of Type A school buses from certain requirements (41 FR 4016, January 28, 1976).

These are only some of the differences in standards for Type A school buses and other types of buses.

APPENDIX E

SAFETY BOARD POSTACCIDENT INSPECTION OF THE TRACTOR-SEMITRAILER BRAKE SYSTEM

Location	Lining thickness (inch)*	Chamber type	Measured stroke (inches)**	Recommended maximum stroke (inches)***
Axle 1:				
Left	6/32	20	2 3/8"	1 3/4"
Right	5/32	20	2 3/8"	1 3/4"
Axle 2:				
Left	4/32	30/30	2 1/4"	2"
Right	7/32	30/30	2 1/2"	2"
Axle 3:				
Left	6/32	30	1 3/8"	2"
Right	7/32	30	1 3/8"	2"
Axle 4:				
Left	10/32	30	2 3/8"	2"
Right	8/32	30	2"	2"
Axle 5:				
Left	10/32	30	2 3/8"	2"
Right	16/32	30	2 1/8"	2"

*Minimum lining thickness required by 49 CFR 570.59(c) is 1/32 inch.

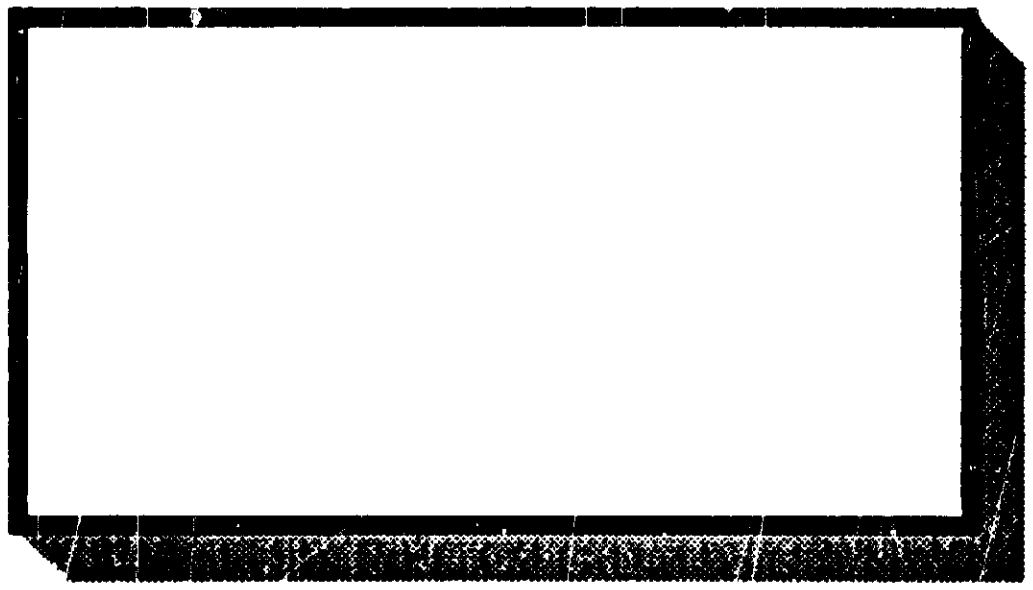
**Length of the pushrod stroke measured during the postaccident inspection.

***Manufacturer-recommended length at which the brakes should be readjusted.

APPENDIX F

GUIDELINES FOR STUDENT DISCIPLINE ON SNYDER SCHOOL BUSES

School Bus Driver Manual



We're still doing it safely.

1992

Sandy Garrett
State Superintendent of Public Instruction
Oklahoma State Department of Education

X. DISCIPLINE

A. On the School Bus

For safety purposes, discipline is even more important on the school bus than in the class room. In spite of the necessity for negative discipline, its function is limited. Negative discipline, a system of "thou shalt nots," has definite uses in maintaining control, but its permanent value is confined to its utility in establishing certain individual constraints. If the negative approach is all that is employed, the driver will soon lose the control needed to be a safe driver.

The school bus can be compared to a classroom on wheels. Therefore, the same basic rules of student behavior that apply to the school building should be applied to the school bus.

B. Function of Discipline

1. To provide an orderly environment inside the bus that will help eliminate distractions to the driver that might interfere in the safe operation of the school bus.

2. To require conduct from the students that will secure pleasant and favorable conditions on the bus at all times.

3. The driver should not administer corporal punishment. Other means, such as special assignment of seats, may be employed. The driver's own corrective measures (other than corporal) should be administered as far as possible.

4. The driver should make the supervisor of transportation or the principal aware of any problems that require discipline.

5. Before dealing with major discipline problems, be certain to bring the bus to a stop in a safe location.

6. All students on the bus should not be punished for the offense of one or two.

7. The driver should possess a positive attitude towards students that will encourage orderly behavior and avoid being overly negative or sarcastic in dealing with students.

C. Bus Rider Rules

Riding a school bus is a privilege and the privilege may be removed for not abiding by the bus rider rules.

<u>Previous to loading</u> students should:

1. Be on time at the designated school bus stops--keep the bus on schedule.

2. Stay off the road at all times while waiting for the bus.

3. Wait until the bus comes to a complete stop before attempting to enter.

4. Be careful in approaching bus stops.

5. Not move toward the bus at the school loading zone until the bus has been brought to a complete stop.