NATIONAL TRANSPORTATION SAFETY BOARD

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RAILROAD/HIGHWAY ACCIDENT REPORT

COLLISION OF A SOUTHERN RAILWAY WORK TRAIN WITH A POLK DISTRICT SCHOOLBUS AT ARAGON, GEORGIA

OCTOBER 23, 1974

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20594
REPORT NUMBER: NTSB-RHR-75-1

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15.Supplementary Notes

This report contains Highway Safety Recommendations R-75-31 through R-75-32 and H-75-17.

16.Abstract

About 7:55 a.m. e.d.t., on October 23, 1974, a Polk District schoolbus carrying 87 students was struck on a grade crossing in Aragon, Georgia, by the caboose of a Southern Railway System work train. The train, which consisted of a locomotive and 12 cars, was backing through the crossing. Failing to stop at or near the point of impact, the train pushed the schoolbus 315 feet down the track. During the movement the caboose overrode the bus as that vehicle rolled onto its roof. The roof of the bus was crushed to the level of the seat tops. There were no ejections or fire. Seven of the occupants of the bus were killed. The busdriver and 71 of the students were known to be injured. None of the occupants of the train were injured.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the driver of the schoolbus to stop his vehicle short of the track until it was safe to proceed, and the failure of a crewmember of the train to guard the unprotected crossing.

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FOREWORD

The accident described in this report has been designated a major accident by the National Transportation Safety Board under the criteria established in the Safety Board's regulations.

This report is based on facts obtained from an investigation performed by the Safety Board in cooperation with the Georgia State Patrol, the Georgia Department of Transportation, and the Southern Railway System, and assisted by the National Highway Traffic Safety Administration's Multidisciplinary Accident Analysis Team of the University of Miami (Florida). The investigation included a public hearing conducted by the Safety Board in Rome, Georgia, on December 3-5, 1974.

The conclusions, the determination of probable cause, and the recommendations herein are those of the Safety Board.

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SS-R/H-7

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D. C. 20594

RAILROAD/HIGHWAY ACCIDENT REPORT

Adopted: July 7, 1975

Collision of a Southern Railway Work Train with a Polk District Schoolbus at Aragon, Georgia, October 23, 1974

SYNOPSIS

At about 7:55 a.m., e.d.t., 1/ on Wednesday, October 23, 1974, a Polk School District schoolbus carrying 87 students, traveling east over an unprotected Southern Railway grade crossing on Bellview Road in Aragon, Georgia, was struck by a Southern Railway work train which was being shoved rearward to the south over the crossing. Both vehicles were moving slowly.

The schoolbus, operated by a school district employee, was driven without stopping onto the grade crossing and into the path of the southbound train. The caboose was the lead car as the train approached the grade crossing and the locomotive shoving the train was nine cars to the north. The train flagman aboard the caboose did not guard the crossing. The bus was hit in the middle left side by the caboose, and was pushed 315 feet down the track by the train before both vehicles stopped. The bus was rolled during the crash sequence onto its roof, and was overridden by the caboose.

Seven students died as a result of the collision; the busdriver and 71 of the students were injured. No one was ejected from the bus. No one on the train was injured.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the schoolbus driver to stop his vehicle short of the track and wait until it was safe to proceed, and the failure of the flagman of the train to guard the unprotected crossing.

FACTS

The Accident

At about 7:55 a.m., on Wednesday, October 23, 1974, Southern Railway Work Train 8284 was backing southward at an estimated speed of 5 to 6 mph toward the Bellview Road grade crossing in Aragon, Georgia.

The train consisted of 13 units; the caboose was on the south end and the locomotive was 9 units north of the caboose. The flagman was

1/ All times are eastern daylight time.

assigned to protect the rearward movement of the train in compliance with Operating Rule 103 2/ of the Southern Railway System.

Subsequent to this accident, the rule was revised and implemented on December 5, 1974. 3/

The conductor was riding on the last car north of the crossing. A road foreman of engines, a brakeman, and the engineer were in the cab of the locomotive. The conductor and the road foreman had the only two portable radios available to the traincrew. After the accident, the road foreman stated that he had taken no exceptions to the operation of the train.

The engineer was seated along the west side of the locomotive--the side from which the bus was approaching. His view directly to the south through the front window was almost completely obstructed by a boxcar which was coupled to the front of the locomotive. However, the engineer stated that he had enough visibility of the crossing at Bellview Road to determine that there was nothing present which would have hampered the movement of the train.

The engineer stated that during the train's southward movement, he was occupied with the operation of the train, which included the blowing of the whistle, observations forward and rearward, and the acknowledgement of radio transmissions from the flagman. The engineer was advised by the flagman when the caboose passed the whistle post. The engineer began sounding the crossing whistle signal, and he repeated this several times.

The flagman was in communication with the engineer in the locomotive through a radio telephone unit on the east wall towards the middle of the caboose. He stated that his decision to use the radio to direct the movement of the train by the engineer was based on his experience as a trainman. No company guidance was available to assist him in making that decision.

2/ Southern Railway System Operating Rule 103 (October 23, 1974): "When shoving cars, precaution must be taken to prevent damage or fouling other tracks. When conditions require, a member of the crew must take a conspicuous position on the leading car, with the proper signals. When moving cars over crossing at grade not protected by a designated employee or by gates, a member of the crew must protect the crossing."

3/ Southern Railway System Operating Rule 103 (Revision, December 5, 1974): "When shoving cars at any location, train and yard crews must take such action as necessary to prevent damage and to avoid fouling other tracks. If a shoving movement must be controlled from the leading end or will require protecting other tracks or other possible movements and protection has not been otherwise arranged, a crew member suitably equipped for the purpose must place himself at or ahead of the leading car.

"Before a train or engine shoves cars into a street or road crossing, a crew member on the ground at the crossing must warn highway traffic, then when the way is clear, he may signal the engine to shove over the crossing. Exception: This paragraph does not apply at a crossing protected by a designated employee."

The flagman, during the approach to the crossing, reported distances to the crossing by radio as required by Operating Rule 7(b) 4/ of the Southern Railway System. He stated that he complied with the rule by going to the south door, looking out, and then returning to the center of the caboose to use the radio. He made intermittent radio transmissions to the engineer. He reported car lengths from the crossing at 15, 10, 5, 3, and 2 lengths. The flagman stated that he observed from the door the south end of the caboose at the crossing; he then looked in both directions but did not see the eastbound schoolbus, he ran back to the radio in the center of the caboose, and he transmitted, "Cab on the crossing, crossing is clear." The train accelerated slightly, the collision occurred, and the flagman claimed that the collision knocked him into the north corner of the caboose and stunned him so that he was unable to notify the engineer of the collision or to apply the brakes of the train from the valve which was located in the center of the caboose. If he had been able to apply the brakes at impact, the train and bus would have moved only an estimated 30 feet instead of 315 feet and the severity of the collision would have been lessened.

En route to pick up the first student that morning, the busdriver had encountered difficulty in crossing the Southern Railway tracks at the prescribed route north of Bellview Road because of a train derailment. That difficulty caused the driver to change his route after the last of the 87 students was picked up. After braking the bus, the driver turned from Prospect Road onto Bellview Road (See Figure 1.) and proceeded eastward toward the crossing at an estimated speed of 30 mph. At this time he observed a locomotive south of Bellview Road on the second track. He stated that the view of the tracks north of Bellview Road was obstructed at this point; therefore he could not see the work train that was being shoved toward the crossing from the north on the track. Although he had not driven a bus over this crossing previously, he was thoroughly familiar with the crossing.

About 750 feet from the crossing the busdriver applied the brakes, shifted into fourth gear, and slowed the bus to an estimated speed of 15 to 20 mph. When the bus was about 100 feet from the track, he sighted the "top part" of the caboose on his left, north of Bellview Road. He was under the impression at that time that the train was stopped. (See Figure 2.)

The busdriver said that he applied his brakes at a point estimated to be about 60 feet from the track. He stated the brakes did not respond; the air pressure gauge warning buzzer did not sound nor did any of the passengers experience a feeling of deceleration.

4/ Southern Railway System Operating Rule 7(b): "When radio communication is used to direct movement, distances will be called out in car lengths such as, 'Ten, nine, eight,' etc. Should contact with employee directing movement be lost, the movement must be stopped immediately."

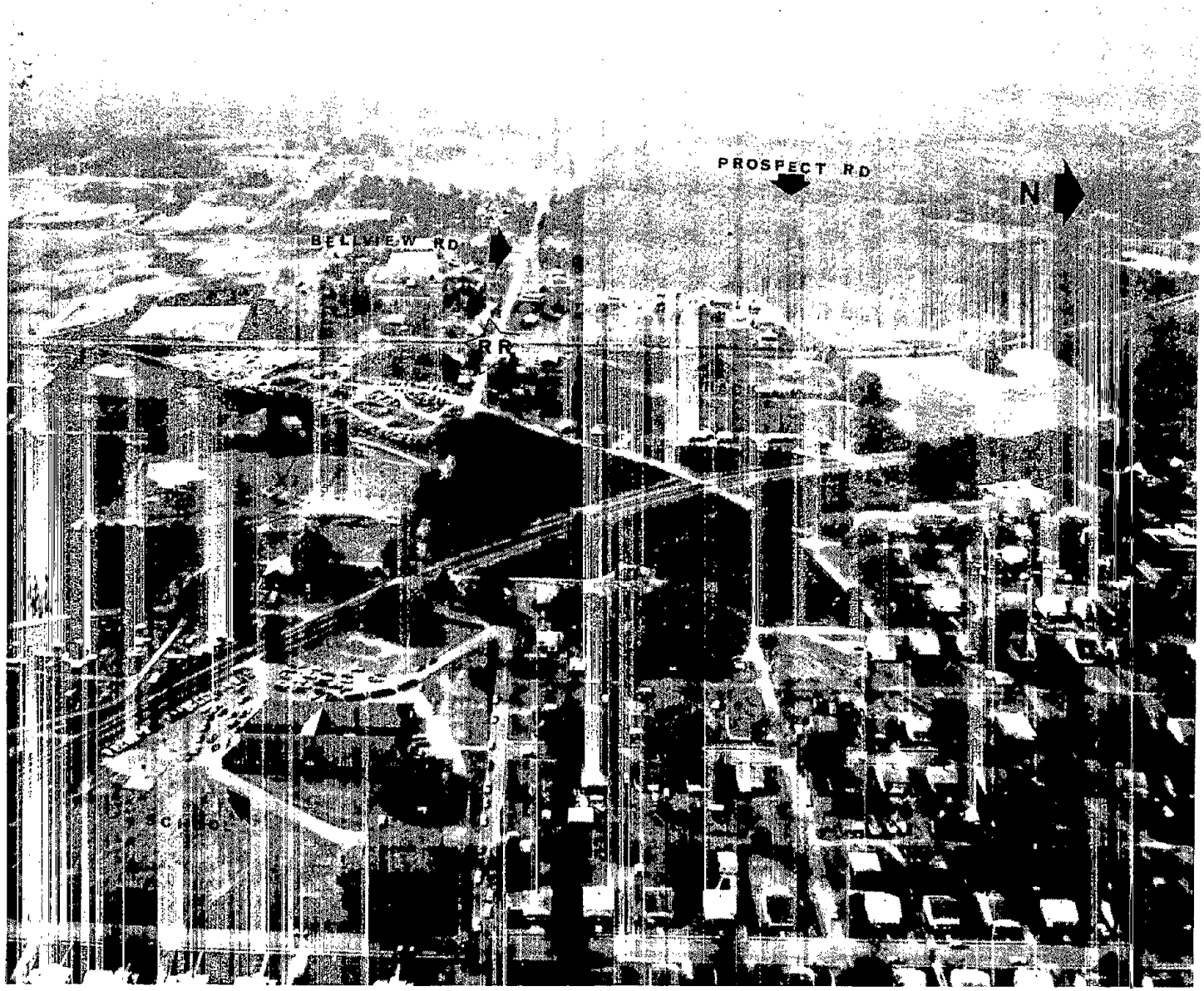


Figure 1. Aerial view of the area surrounding the accident site.

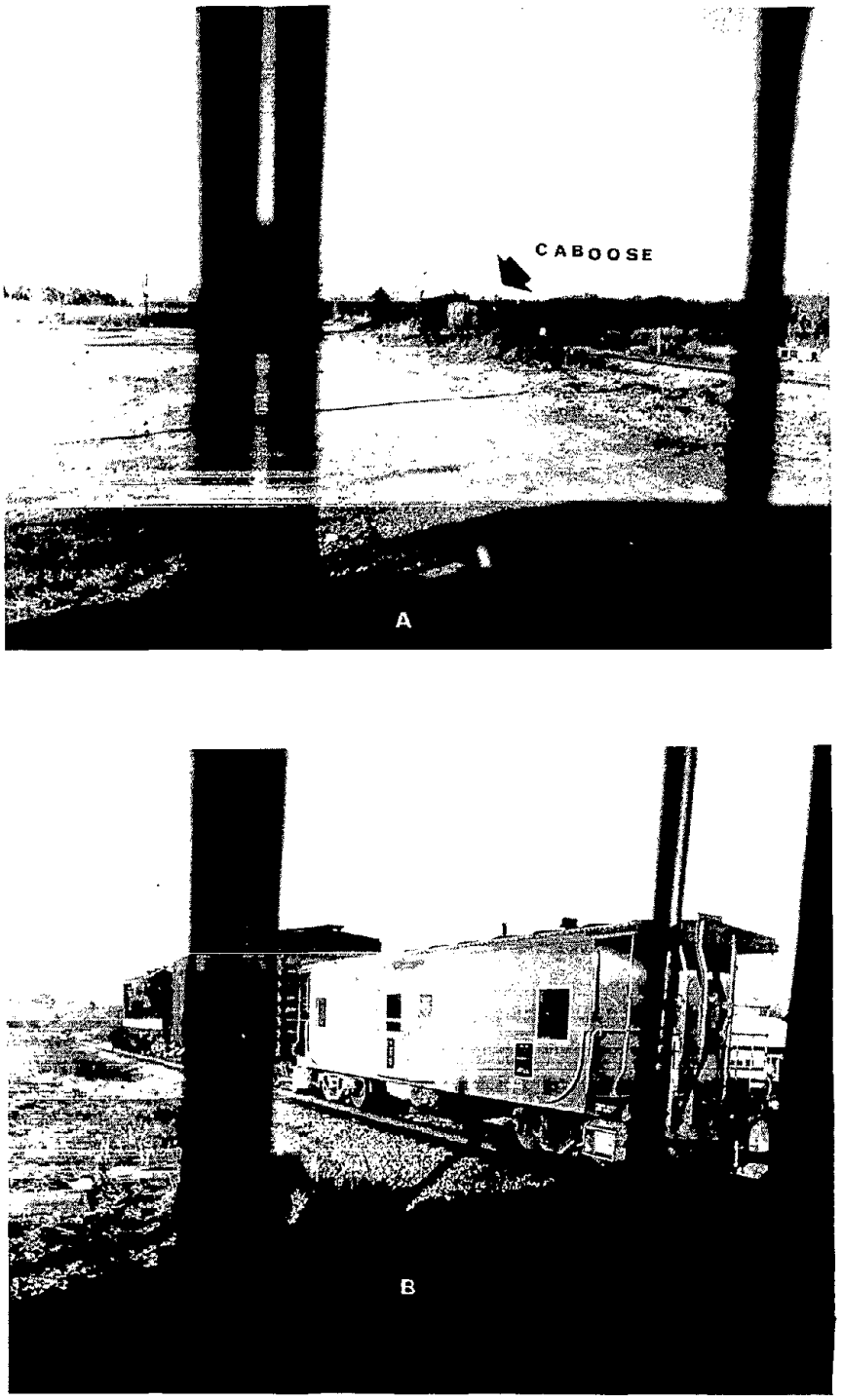


Figure 2. Views of the caboose from driver's eye level in a schoolbus: (A) Front bumper of bus 50 feet west of west rail and south end of caboose 369 feet north of center of crossing; (B) front bumper of bus 20 feet west of west rail and caboose 25.6 feet north of center of crossing.

The driver stated that he applied the brakes again when the bus reached an estimated 40 feet from the track and when the driver realized that the caboose was moving towards the crossing. Again, according to the driver, the brakes did not respond. The busdriver shifted gears and attempted to accelerate without success as the front of the bus moved onto the track. Witnesses estimated the speed of the bus as it entered the crossing to be in the range of 5 to 10 mph. The driver did not apply the air-release rear wheel parking brakes nor did he at any time hear the train horn or observe any member of the traincrew.

A second bus was stopped on the east side of the track facing west. The driver of the second bus left his vehicle when the collision occurred and ran north along the east side of the moving train toward the locomotive.

The protruding coupler of the caboose struck and penetrated the outer wall of the schoolbus. The eastbound momentum of the bus was stopped within 2 feet after impact and the bus was pushed along by the slow-moving train. The deceleration of the train by the impact was so slight that the crew in the locomotive did not feel the collision. The crew positions in the locomotive at the moment of impact made it unlikely that they could have seen the bus at collision.

As the bus was shoved southward, the right rear tires dropped off the pavement and into a ditch which was located on the shoulder south of the pavement edge and west of the track. This, in combination with its sideward movement, caused the bus to begin a rotation around its longitudinal axis which continued as the right rear tires came in contact with crossties on the west side of the track.

As the bus rolled to its right, the lower body wall made contact with the steel rails of the track. Almost simultaneously the bus struck and knocked down a railroad signal post and its concrete base. (See Figure 3.) Under these forces, the bus rolled onto its right side and the coupler of the caboose made contact with the underside of the vehicle. As the train continued to shove the bus southward, the bus rolled under the coupler and upward leverage provided by the bus structure on the coupler lifted the south end of the caboose off the track. Because the truck was not pinned to the caboose frame (a normal condition), the caboose lifted off its south truck.

When the bus had rolled 180 degrees, the roof was in full contact with the rails of the track. Contact by the bus at that moment with a track switching device and other parts associated with the separation of the mainline and switch track, some 80 feet south of the pavement edge, was the source of additional damage to the roof of the bus. Evidence of contact between the bus, its occupants, and those devices was found throughout that section of track.

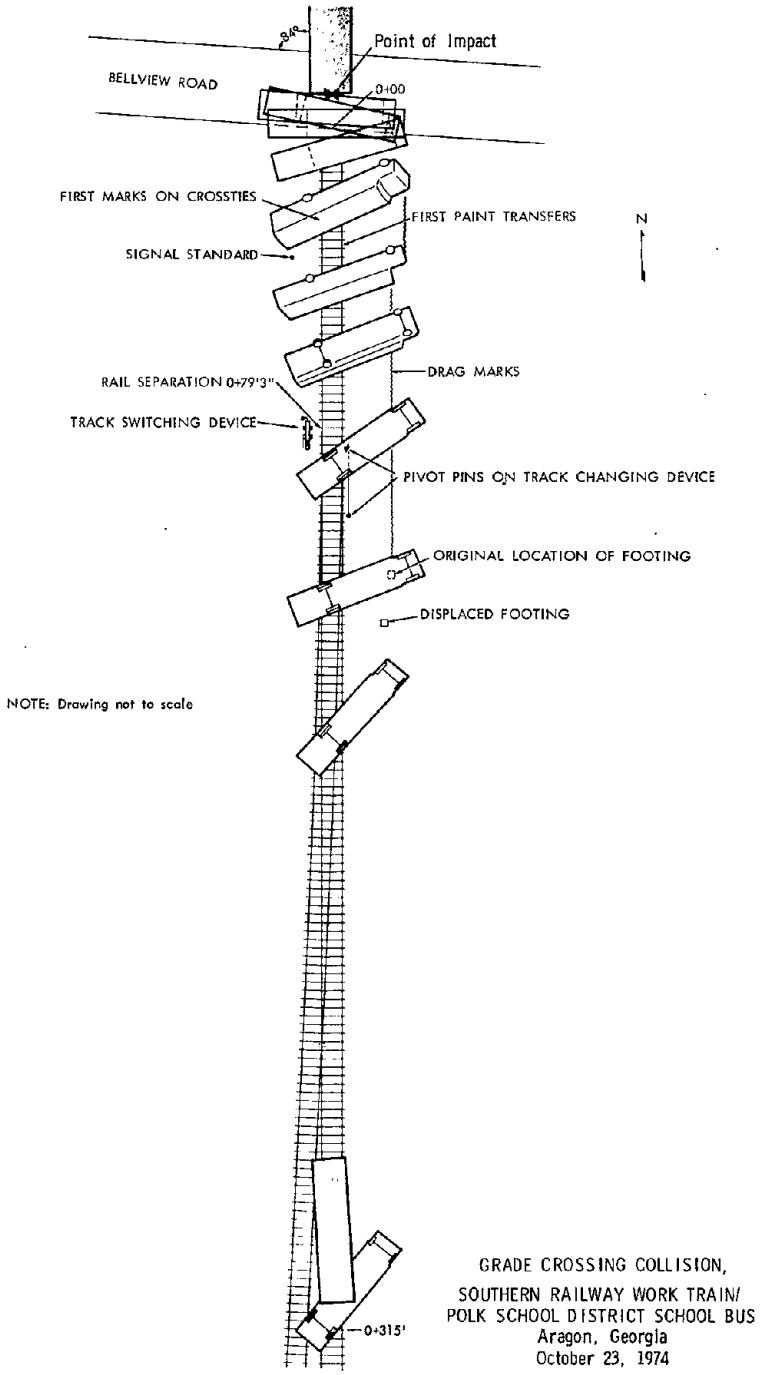


Figure 3. Crash sequence.

The bus next struck and dislodged a concrete foundation which was located 115 feet south of the pavement edge. The impact caused additional crushing and a tear in the right front section of the bus. Window columns on the right side failed at that time as the weight of the caboose crushed the bus downward against the steel rails of the track. Subsequently, a section of the roof on the middle-right side collapsed into the interior of the bus. Four of the seven occupants of the bus who sustained fatal injuries were located in that section of the bus. (See Appendix B.)

The engineer, immediately following the flagman's last radio transmission, saw some dust fly up in the vicinity of the crossing. He asked the road foreman to determine if the crossing was clear on his side. The road foreman crossed to the east side of the locomotive and saw the second busdriver running towards them waving his arms. Until then, the crewmembers in the locomotive were unaware of the collision. The brakes were put into emergency and the train stopped. The bus came to rest in an inverted position with the south end of the caboose resting on the bus' underside, 315 feet from the south edge of the crossing.

No one was ejected from the bus. A fire which started in a stove in the caboose was quickly extinguished. Rescue activities began immediately.

Accident Site

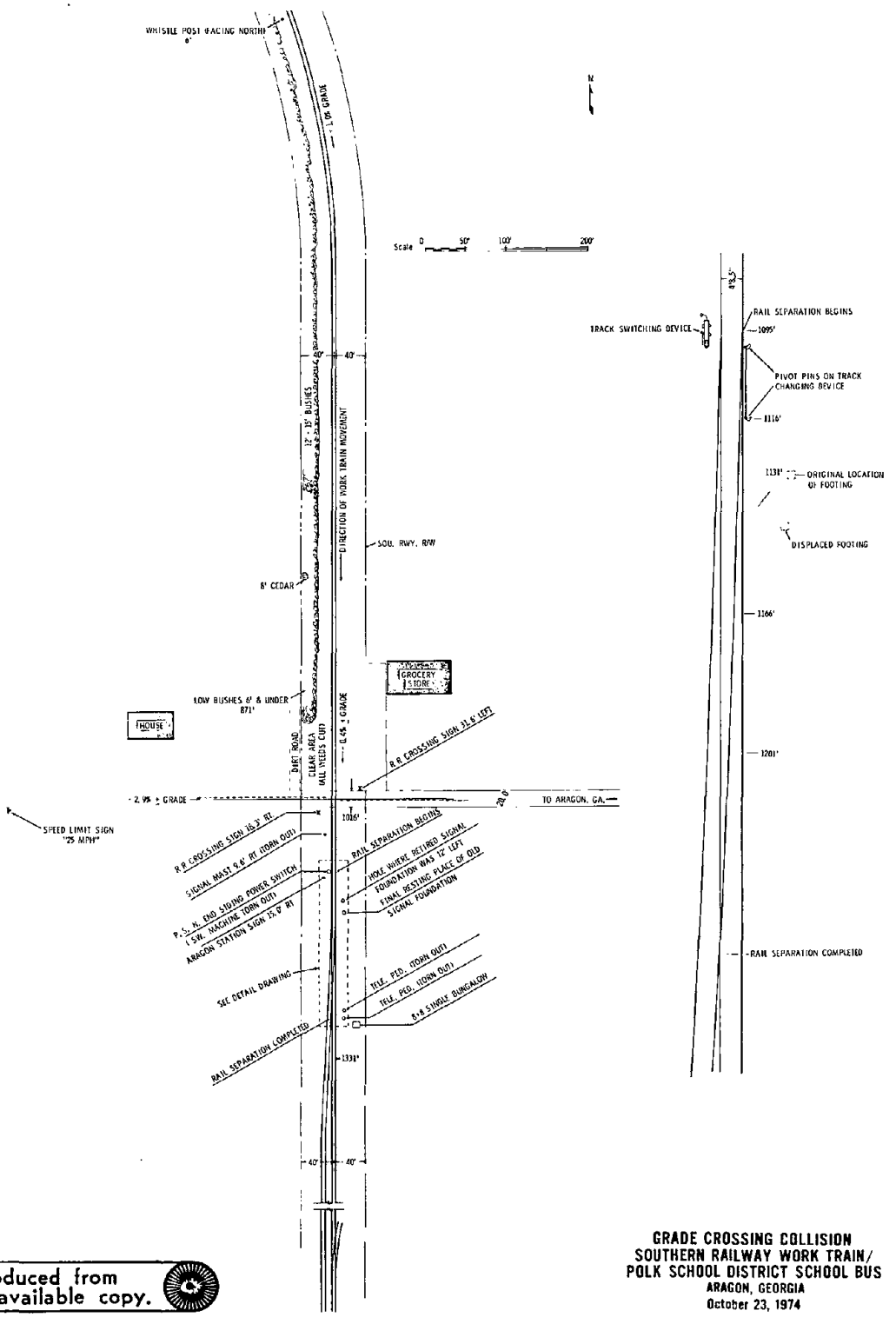
Roadway -- Bellview Road is a 2-lane county road which in the vicinity of the grade crossing runs east and west. The pavement, 20 feet in width, is asphalt surfaced with noticeable patching; it is slightly crowned and is bordered on both sides by unimproved dirt shoulders. The pavement at the crossing was reduced to a width of 19 feet 6 inches because of deterioration of its edges.

A speed limit sign of 25 mph is posted approximately 400 feet west of the crossing, and a standard railroad crossbuck warning sign is located on the shoulder of the road adjacent to and on both sides of the track. At the time of the accident, there were no other traffic control signs, signals, or warning devices on either approach. 5/ (See Figure 4.)

A traffic count in an April 5, 1974, diagnostic survey of this crossing showed the daily motor vehicle traffic to be 1,414 and the train traffic to be 18 per day. A traffic count conducted on October 25, 1974, showed the daily motor vehicle traffic to be 2,328 and the train traffic to be 26 per day. 6/ Although an exact count was not determined, it was

5/ Subsequent to the accident, the crossing was equipped with active protection: automatic gates, flashing lights, and bells.

6/ Since many sightseers were still coming to view the accident site, this count may be invalid.



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GRADE CROSSING COLLISION
SOUTHERN RAILWAY WORK TRAIN/
POLK SCHOOL DISTRICT SCHOOL BUS
ARAGON, GEORGIA
October 23, 1974

Figure 4. Accident site.

estimated that at least 20 schoolbuses used the crossing on an average school day.

Southern Railway records on the Bellview crossing prior to this accident and dating back to 1966 noted four railroad/highway accidents which resulted in minor personal injuries and no fatalities. Data regarding visibility distances at the grade crossing were gathered by the Southern Railway System on November 26, 1974, under conditions approximately similar to those present at the time of the collision. 7/

The Railroad -- The single track runs north and south in the vicinity of the crossing and is straight for approximately 570 feet north of the crossing. At that point, the track curves to the west. A second track begins 80 feet south of the crossing and from that point south runs somewhat parallel to the mainline track. See Figure 4 for the location of railroad devices and other physical objects along the track.

Environmental Factors -- On the morning of the accident, the sky was clear. The road and track surfaces were dry. The temperature was about 35°F with no measurable winds.

Sunrise was at 7:51 a.m., e.d.t., with the sun on the horizon at 13 degrees south of east. Since the schoolbus involved in this accident was traveling due east, the sun was 13 degrees to the driver's right. In that position, the sun did not interfere with the driver's view of the approaching southbound train.

Vehicle and Vehicle Occupants

The Schoolbus -- The schoolbus in this accident was a 66-passenger Thomas-built body mounted on a 1972 Ford frame. It was owned and operated by the Polk School District. The bus was in good condition before the accident on August 22, 1974. Specifications of the bus can be found in Appendix A.

Schoolbus Driver -- The driver had been driving a schoolbus for the district for 5 years. No passenger interviewed by Safety Board investigators commented adversely on the driving ability or demeanor of the busdriver. His driving records with the State of Georgia and the district were without any notations of traffic accidents or violations. However, he had neglected to renew his driver's (chauffeur, without restrictions) license which had expired 35 days before the accident.

The driver's medical history revealed a cardiovascular problem. However, a medical examination conducted on August 13, 1974, showed him to be in good physical condition, with the above-mentioned problem noted on the report of the examination as "now well."

7/ Details on the sight clearance at the crossing can be found in Safety Board Headquarters, Washington, D.C. 20594.

The driver on the morning of the accident exhibited no signs of physical or mental incapabilities.

Schoolbus Passengers -- There were 87 students aboard the bus, of which at least 22 were standees. They ranged in age from 6 to 17 years.

The busdriver and 71 of the students were injured. Of the 7 fatally injured passengers, 3 were standees. Of the 4 severely injured passengers, none were standees. A summary of injury severity in this accident can be found in Appendix B.

The Work Train -- The order of cars of Southern Railway work train 8284 was a caboose, two panel cars, two gondola cars, one tank car, two coaches, one boxcar, one diesel locomotive, one boom car, one derrick car, and one boxcar.

The bay-window caboose, painted red, was 11 feet 6 inches in height, 38 feet 3 inches in length, 10 feet 9 inches in width, and had a light weight of 55,000 pounds. The unit was equipped with three airbrakes, valves -- one on each platform and one in the center interior of the caboose on the west side. The handset of the radio telephone was attached by an 85-inch extension cord to the jack on the caboose's east side bay window. This location is convenient for communication while observing the train. (See Figure 5.) An additional radio jack was located in the west side bay window. There were no audio devices or warning lights installed on the caboose.

In addition to the caboose and locomotive, one coach and the derrick were equipped with a fixed radio-telephone unit. No other cars of the work train were so equipped.

The locomotive unit was the General Motors GP7. It was equipped with airbrakes and an air-operated 5-chime horn and bell. The horn was located on the roof of the locomotive cab with two of the horn chimes facing forward and three facing to the rear.

An emergency braking test was conducted on October 31, 1974, with a train and with conditions similar to those present at the time of the collision. The results of the test were as follows:

Speed (mph)	Distance to Stop
8	56' 2"
6	35' 5"
6	27' 10"
4	26' 1"
2	13' 10"

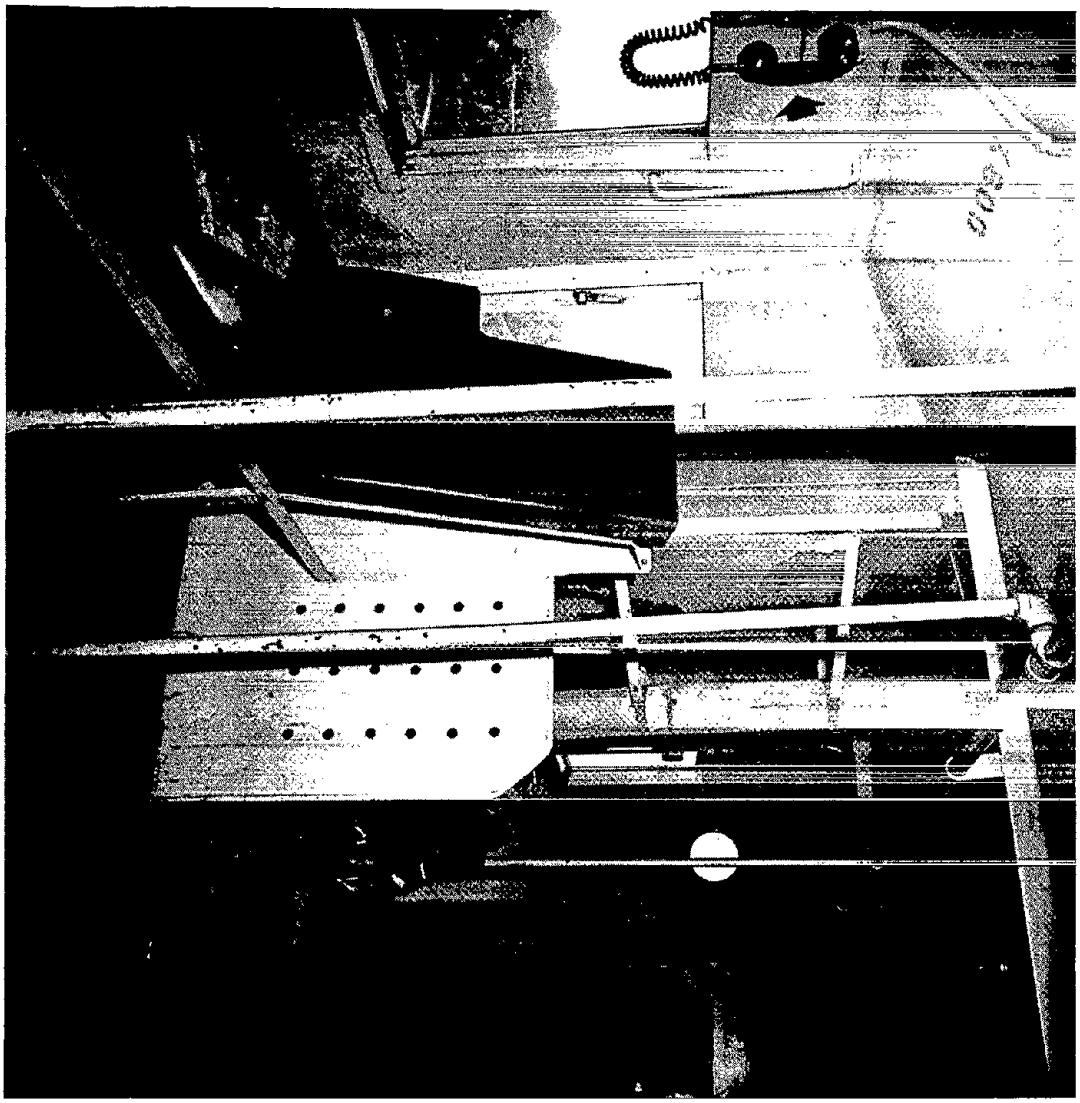

Figure 5. Interior of the caboose. Arrow indicates the handset of the radio-telephone which was affixed to the east wall (picture taken facing end of caboose which struck bus).

The Crew of the Train -- All train crewmembers were qualified under existing requirements of the Federal Railroad Administration as to hours of service regulations.

Also aboard the train were members of the workcrew. No members of the traincrew or workcrew were injured.

Vehicle Damage

Schoolbus -- The primary modes of failure of the bus structure included collapse of vertical roof supports and flattening of the arched roof structure. A number of window columns failed at the top and bottom of the columns, leaving the center position of the columns intact. The side wall of the bus, which supported the weight of one end of the caboose, was grossly distorted. There was a separation of one heavy-gauge side rail at its joint.

Three postcrash inspections of the bus' mechanical components critical to safe operation were conducted. The last and most extensive of the inspections was conducted on October 28 and 29, 1974, by engineers of Ford Motor Company, who were assisted by representatives of the Georgia State Patrol, the Polk School District, and the Safety Board. None of the examinations 8/ revealed any mechanical defects which could have affected detrimentally the operation of the airbrake system on the morning of the collision.

Work Train -- The caboose sustained some crushing of the steps on the southeast corner and some damage to the underside of the south end of the car.

Rescue Activities

Several members of the traincrew and the workcrew immediately went to the bus and helped with the extrication of passengers. Some passengers also joined in rescue efforts.

Many of the less injured passengers evacuated the bus, without assistance, through window openings. The driver was injured too severely to evacuate without help.

Several of the injured passengers were transported to local hospitals in the second schoolbus. There were no delays in the movement or treatment of the injured. Rescue operations were orderly and expeditiously executed.

8/ Details on the mechanical inspections of the schoolbus can be found in public docket SS-R/H7 at Safety Board Headquarters in Washington, D.C. 20594.

Pupil Transportation System

The average number of children bused daily to Polk County's public schools at the time of the accident was 4,677, or about 72 percent of the total school enrollment. This movement of students involved 41 buses, 9/ 41 drivers, 41 routes, and 125 trips daily. The passenger load each trip averaged 75 students per 66-passenger capacity bus -- a 13.6 percent overload. A 20-percent overload is permitted by State Department of Education policy. 10/

A transportation director was delegated responsibility for pupil transportation supervision within the district. His duties included the full range of functions normally associated with the busing of students to and from school. Included in those duties was responsibility for safety supervision of schoolbus drivers.

The director stated after the accident that he conducted safety field checks of bus operations in response to complaints or requests and not on a regularly scheduled basis. He said that prior to the accident, he had on occasion investigated complaints that schoolbuses had failed to stop at grade crossings and found the complaints to be unjustified.

The director was convinced that the busdriver in this accident and all other district drivers understood their responsibilities at grade crossings. However, on the day following the accident, Safety Board investigators and Georgia State Patrol troopers witnessed a second district schoolbus carrying children fail to stop prior to traversing the Bellview crossing.

Grade Crossing Safety Improvement

The Bellview crossing was inventoried and surveyed by a diagnostic team from the Georgia Department of Transportation in April 1973. From that survey, the crossing was assigned a hazard index rating of 6.81. 11/

9/ Ten additional buses were on order at the time of the accident.

10/ "School Transportation Surveys," Georgia State Board of Education: "The loading limit of any schoolbus shall not exceed 20 percent above the manufacturer's rated seating capacity of the bus. Any route that would cause a violation of this standard shall be considered as sufficient evidence to require a reassignment of buses or a rearrangement of routes by the system board of education and the State Department of Education to bring the service within the standard."

11/ Hazard-index rating calculations of this crossing can be found in public docket SS-R/H7 at Safety Board Headquarters, Washington, D.C. 20594.

The survey team recommended that the crossing be provided with active protection. 12/ Southern Railway participated in the survey and provided engineering data for the implementation of active protection. On November 25, 1974, bells, flashers, and gates were installed.

ANALYSIS

Operation of the Schoolbus

The schoolbus failed to stop at the crossing as required by Georgia State law. The driver of the schoolbus testified that he attempted to stop the bus, but the brakes had no apparent effect. The evidence indicated that the brakes were in good condition and could have stopped the bus within 60 feet at a speed of approximately 15 mph. Furthermore, the bus was seen to decelerate in its approach to the track. It is likely, therefore, that the brakes did not fail, but that the busdriver did not operate the brakes in a manner to stop short of the track.

The reason the driver did not stop is unknown. According to his statement, when he first saw the train it was not moving and he probably believed he could safely cross the track without stopping. In this connection, the law 13/ states "...while so stopped shall listen and look in both directions along such track for any approaching train, and for signals, indicating the approach of a train, ..."

Operation of the Train

The engineer relied on the flagman to provide him with information he required to operate the train in a safe manner. The radio communica-

12/ The State of Georgia considers any crossing with a hazard index rating of over 3.0 a candidate for active protection, separation of the grade, closing of the crossing, and/or relocating the track.

13/ Georgia Laws 1974, p. 633 at 666 (68A-703): "Certain vehicles must stop at all railroad grade crossings. (a) The driver of any motor vehicle carrying passengers for hire, or of any schoolbus carrying any school child, or of any vehicle carrying explosive substances or flammable liquids as a cargo or part of a cargo, before crossing at any grade track or tracks of a railroad, shall stop such vehicle within 50 feet but not less than 15 feet from the nearest rail of such railroad and while so stopped shall listen and look in both directions along such track for any approaching train, and for signals, indicating the approach of a train, except as hereinafter provided, and shall not proceed until he can do so safely. After stopping as required herein and upon proceeding when it is safe to do so the driver of any said vehicle shall cross only in such gear of the vehicle that there will be no necessity for changing gears while traversing such crossing and the driver shall not shift gears while crossing the track or tracks. (b) No stop need be made at any such crossing where a police officer or a traffic-control signal directs traffic to proceed."

tions he received from the flagman indicated to the engineer that he was being supplied with that information. Additional information on conditions at the crossing and along the west side of the train would have been available to the engineer had he opened the side window and leaned out so that his head was outside; but he did not.

The road foreman of engines, an official of the railroad, stated that he closely observed the engineer, he was aware of the rearward movement being controlled by radio communications, and he had no criticism of the crewmembers in their operation of the train. However, the road foreman's testimony indicated that he knew there were only two portable radio sets on board. He knew that he had one and the conductor had the other. This meant that the flagman did not have a portable radio and therefore was protecting the crossing from the caboose. The foreman should have known that this was improper procedure to protect a crossing and should have so instructed the engineer.

On the day of the accident, the flagman had not requested the use of either of the portable radio sets nor had he made arrangements for or attempted to use hand signals for the southward movement. Obviously, he intended to use the caboose radio for all communications with the engineer. The crewmembers did not question whether the radio being used by the flagman was a portable set or the caboose radio.

The position of the caboose radio set required that the flagman be in the center of the caboose to use the radio. Standing in this position, he could look eastward through the bay windows or southward through the opened end-door to observe the track. However, this provided a line-of-sight restricted to immediate conditions on the east side of the track and the line of travel directly in front of the backing caboose. It follows then that for the flagman to report actual traffic conditions at or near the crossing, he would have had to go out and make his visual observations from the platform of the caboose and then return about 19 feet to the radio to transmit those observations to the locomotive engineer. The Georgia State Patrol, in its report of this accident, stated that a person uses 4.5 seconds to run back to the radio from the door of the caboose and remove the handset from its mounting for use.

The radio transmission of the flagman from the center of the caboose and just prior to impact was, "Cab on the crossing, crossing is clear." He stated that he made that transmission after returning from the leading platform where he observed the crossing as the south edge of the caboose reached the north edge of the crossing. He said he did not see the approaching schoolbus. Had he actually completed the above actions as he claims, the south end of the caboose would have traveled beyond the south edge of the crossing while he was moving to the radio and the collision would not have occurred as it did.

The schoolbus was probably about 300 feet west of the crossing when the caboose was 2 car lengths, or 100 feet, from the crossing. 15/ If the flagman had looked to the west from the platform of the caboose at that location, he could have sighted the approaching bus because there were no line-of-sight obstructions from that point on the track to that point on the road. Based on his own statement, the flagman first sighted the eastbound schoolbus from the center of the caboose when the bus loomed in front of the caboose immediately preceding the collision.

If the flagman had been on the leading platform when it became apparent that the bus would not stop before entering the crossing, he could have stopped the train short of a collision by activating the air brake valve at any point more than an estimated 30 feet north of the point of impact. Consequently, it is apparent that the flagman's observations were not made from the leading platform.

CONCLUSIONS

1. The driver of the schoolbus was not physically incapacitated prior to the collision.

2. There is no evidence that the mechanical condition either of the schoolbus or the train contributed to the accident.

3. The driver of the schoolbus, had he been looking, and the flagman, had he been on the rear platform of the caboose, had an unobstructed view between vehicles when they were within a safe stopping distance from their respective edges of the crossing.

4. The driver of the schoolbus and the flagman on the caboose understood their respective responsibilities for the safe movement over the grade crossing. Neither the driver nor the flagman complied with those responsibilities.

5. The requirement for schoolbuses to stop short of railroad track(s) at a grade crossing is more than a legislated formality. It provides the time necessary to detect potential hazards and thereby insures safe passage. Schoolbus drivers need to be made aware of the necessity of stopping at all rail-highway grade crossings.

6. It was essential to the safe operation of the train during its rearward movement that the actions of the traincrew be monitored, and if necessary questioned, by the road foreman of engines. The road foreman took no exception to the manner in which any member of the crew was performing his duties.

15/ Based on the average speed for the bus of 15 mph and the train of 5 mph.

7. The number of students on the bus, which was in excess of the State of Georgia's and the manufacturer's rated passenger-capacities of the vehicle, did not contribute to the accident.

8. Had the caboose been equipped with a radio jack at the south end or the flagman provided with a portable radio, the flagman could have remained on the leading platform during the entire movement. The use of hand signals by the flagman to direct the movement of the train would have permitted him to stay on the leading end of the caboose during the entire movement.

9. If the flagman had elected to communicate with the engineer by hand signals, the engineer would have been able to see his signals.

10. The failure of the flagman to notify the engineer of the collision and/or apply the airbrake valve available to him in the caboose allowed the train to push the schoolbus over 300 feet from the point of impact before stopping. That movement contributed to the severity of injuries and losses of life.

11. Formal guidelines had not been promulgated to assist traincrews in the selection of the use of radio or hand signals to direct the movement of trains.

PROBABLE CAUSE

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the schoolbus driver to stop his vehicle short of the track until it was safe to proceed, and the failure of the flagman of the train to guard the unprotected crossing.

RECOMMENDATIONS

The National Transportation Safety Board recommends that:

1. The Federal Railroad Administration (FRA) promulgate regulations governing railroad operating rules for the use of radio communications and flagging when trains are being pushed (shoved) across grade crossings. (Recommendation R-75-31)

2. The FRA promulgate regulations to require that if radios are to be utilized for directing rearward movement of trains, the radios must be installed so that they can be used by an employee from the leading platform. (Recommendation R-75-32)

3. The Polk School District, State of Georgia, establish a formal procedure for frequent field checks of schoolbus drivers to insure their compliance with the District's safety policies and the State of Georgia's Uniform Rule of the Roads. (Recommendation H-75-17)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JOHN H. REED
Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

July 7, 1975

APPENDIX A

SCHOOLBUS DATA

Specification of the Schoolbus

The Thomas-built body schoolbus had 22 passenger seats, each measuring 39 inches in width and 34 inches in height. The 1972 Ford chassis was a B700 with a gross vehicle weight rating (GVWR) of 23,000 pounds. It was equipped with a Clark 285 5-speed transmission, a Ford gasoline 361 CID engine (182 horsepower @ 3800 r.p.m.), a Rockwell single-speed H170 rear axle (7.17 ratio), 9.00 x 20 tires, power steering, and air-brakes.

The Bendix Tru-flow 400 compressor had two air tanks for the service brakes, one for releasing the parking brake and one for activating the stop signal on the driver's side of the bus. The service brakes were Bendix self-adjusting wedge-type, 15 x 3 front and 15 x 6 rear. Brake pedal travel for full brake application was 2.9 inches. The odometer read 27,650.

Performance Calculations 1/

Speed -- The calculations for speeds were based on the above specifications and a bus loaded to its full GVWR.

The results of those calculations are as follows:

Gear Positions	Transmission Ratio	Max. Vehicle Speed (mph)	Min. Vehicle Speed Without Lugging (mph)
1	6.99	8.3	0
2	4.09	14.2	8.3
3	2.24	26.0	14.2
4	1.47	39.6	26.0
5	1.00	58.3	39.6

Stopping distances -- The calculations for stopping distances were based upon certain assumptions, the most significant of which were a driver-reaction time of 0.35 seconds, a dry concrete road surface coefficient of friction of 0.75, and brake torque values based upon dynamometer testing. The computer calculations were for a bus equipped

1/ The calculations were prepared through the use of computers by the Ford Motor Company at the request of the Safety Board.

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with the size and type of brakes that were on Polk School District bus 72-3. The results of the calculations were as follows:

Speed (mph)	Stopping Distant (feet)
15	21
20	34
25	49
40	132
50	200

Empirical testing on many types of vehicles indicates that the above calculated stopping distances may be greater than actual stopping distances.

Crash Damage

The type of failure of window columns noted in this accident (Figure 6) has been called a "critical localized failure" in other cases. It served to permit the collapse of the roof structure onto the seats below. This indicates that the window column did not maintain its maximum strength because of the localized failure at either end. This problem has been found in other accidents involving schoolbuses 2/ and interstate buses. 3/ It cannot be determined whether a differently designed bus column would have been able to resist the weight of the caboose; however, some schoolbuses have been redesigned voluntarily to provide reinforcement at the top and bottom of window columns since the Monarch Pass accident of 1971.

2/ National Highway Traffic Safety Administration, "Monarch Pass, Colorado, Schoolbus Crash," 1971 DOT HS600779.

3/ National Transportation Safety Board, "Interstate Bus/Automobile Collision and Rollover, on Indiana Route 57, South of Petersburg, Indiana, November 24, 1969," NTSB-HAR-71-4.

National Transportation Safety Board, "Bus/Station Wagon Collision Followed by Bus Overturn, U. S. Route 66 near Marshfield, Missouri, October 10, 1971," NTSB-HAR-73-1.



Figure A-1. Bus and caboose in final position. Note (arrow) airbrake valve.

APPENDIX B

BUS OCCUPANT INJURY PRODUCTION

The occupants of the bus were subjected to a low lateral force when the train struck the left side of the bus. This would have caused the occupants to move from right to left and make contact with each other and components of the interior of the bus. As the bus rolled over, the occupants were tumbled within the interior of the bus. There was no evidence of any occupants being ejected.

The seats in the bus were of the high-back type. They were padded and without contact points of exposed metal seat frame rails. All the seats remained secured to the floor. This negated their mixing in with tumbling bus occupants. These injury-reducing factors in combination with the low impact speed of the train accounted for the low number of severe injuries. Sixty-three of the 87 occupants sustained minor injuries alone.

Most of the fatally injured victims suffered massive chest and head injuries. Four of the fatally injured victims were found together near the center section of the bus. They were crushed between the top of a single seat and the roof of the bus. It was not possible to determine if these four occupants sustained fatal injuries as the bus started to roll or after the caboose climbed up onto and came to rest on top of the inverted bus. A fifth fatally injured victim was partially ejected through a side window of the bus and suffered severe head injuries. The position of the remaining two victims after the vehicles came to rest could not be determined.

A summary of the severity of injuries in this accident follows:

Severity Code	Severity Category	No. of Occupants
0	No injury	2
1	Minor	63
2	Moderate	5
3	Severe	4 (including driver)
4	Serious	None
5	Critical	None
6	Fatal	7
	Unknown Injury	6

The Abbreviated Injury Scale (AIS) was developed in January 1968 under the auspices of the American Medical Association. This scale

provides a definitive classification system for traumatic injuries particularly those caused by automobile collisions. Briefly, the scale is as follows:

Severity Code	Severity Category
0	No Injry
1	Minor
2	Moderate
3	Severe (not life-threatening)
4	Serious
5	Critical (survival uncertain)
6	Fatal (within 24 hours)