NATIONAL TRANSPORTATION SAFETY BOARD

RAILROAD/HIGHWAY ACCIDENT REPORT

PENN CENTRAL FREIGHT TRAIN/SCHOOLBUS COLLISION NEAR CONGERS, NEW YORK

MARCH 24, 1972

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D.C. 20591
REPORT NUMBER: NTSB-RHR-73-1

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16. Abstract
At about 7:55 a.m., on Friday, March 24, 1972, an eastbound schoolbus was driven across a grade crossing on Gilchrist Road, near Congers, N. Y., and was struck by the lead locomotive of a northbound Penn Central freight train. Except for a stop sign, at which the busdriver failed to stop, and a standard railroad-crossing sign, the crossing was not specially protected.

After impact the schoolbus was driven 1,116 feet down the track by the train, and the body structure of the bus disintegrated. The rear section of the bus was torn loose, fell beside the track, and overturned with a number of students underneath. Two of the several students who were ejected from the remaining portion of the bus passed through separated floor sections and fell between the rails into the path of the train.

As a result of the accident five students died, and the busdriver and all 44 remaining students were injured. None of the train crew was injured.

The National Transportation Safety Board determines that the cause of this accident was the failure of the schoolbus driver to stop at the stop sign until the crossing was clear of railroad traffic. Contributing to the accident was the unnecessary routing of the schoolbus over a not specially protected railroad/highway grade crossing.

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Railroad/highway grade-crossing accident, schoolbus-body construction, schoolbus-passenger crash-injury protection, pupil-transportation safety, grade-crossing protection devices.

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FOREWORD

The accident described in this report has been designated as 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. Assisting in the investigation were the Cornell Aeronautical Laboratory (Calspan) and the Federal Railroad Administration. Cooperation was also received from the District Attorney of Rockland County, N. Y., the Town of Clarkstown, N. Y., and the New York Department of Transportation. The investigation included a public hearing conducted by the Safety Board in New City, N. Y., on April 11, 12, and 13, 1972.

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

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Penn Central Freight Train/Schoolbus Collision, near Congers, New York, March 24, 1972

I. SYNOPSIS

At about 7:55 a.m., on Friday, March 24, 1972, a schoolbus was driven across a grade crossing on Gilchrist Road, near Congers, N.Y., and was struck by the lead locomotive of a Penn Central freight train. Although there were a stop sign, at which the busdriver failed to stop, and a standard railroad-crossing advance-warning sign at the accident site, the crossing was not specially protected by any active devices.

After impact, as the schoolbus was pushed 1,116 feet down the track by the train, the body of the bus disintegrated. The rear section of the bus was torn loose, fell beside the track, and overturned with a number of students underneath. Two of the several students who were ejected from the remaining portion of the bus passed through separated floor sections and fell between the rails.

As a result of the accident, five students died, and the busdriver and all 44 remaining students were injured. No member of the traincrew was injured.

The National Transportation Safety Board determines that the cause of this accident was the failure of the schoolbus driver to stop at the stop sign until the crossing was clear of railroad traffic. The reason for this failure could not be determined.

Contributing to the accident was the unnecessary routing of the schoolbus over a not specially protected railroad/highway grade crossing. Contributing to the number of fatalities and the severity of injuries were: (1) the lack of structural integrity of the body of the schoolbus, (2) the absence of highback padded seats and an occupant-restraint system in the schoolbus, (3) the presence of standing students in the bus, and (4) the action of the coupler of the lead locomotive, which caused the crash forces to be concentrated on the bus.

II. FACTS

The Accident

At about 7:55 a.m., on Friday, March 24, 1972, Penn Central freight train WV-1 was approaching the Gilchrist Road grade crossing near Congers, N. Y., from the south at an estimated speed of 25 m.p.h. (The posted track speed is 40 m.p.h.). As the lead locomotive passed the whistle post, 1,659 feet south of the crossing, the engineer began sounding the standard crossing signal. The locomotive's bell was ringing automatically, and the fixed dual-sealed beam, white headlight was burning.

When the train reached a point approximately 500 feet south of the crossing, the three crewmembers in the lead locomotive saw an eastbound schoolbus, which they estimated to be about 480 feet west of the crossing. The schoolbus appeared to them to be moving at a constant rate of speed.

The busdriver drove the schoolbus from its garage at 7:30 that morning. Before making his first pickup, the busdriver encountered an unexpected detour on Gilchrist Road. The detour made it necessary for the busdriver to drive the route in reverse of the course normally followed. Thus, on that particular morning, the schoolbus approached the railroad crossing 20 minutes later than usual, from the opposite direction and with 49 passengers instead of six.

When the bus was about 600 feet west of the crossing, a student seated in the rear heard the train horn and saw the train emerge from a forested area south of Gilchrist Road. (See Figure 1.) From that point on, both vehicles remained in sight of each other.[1]

Other passengers in the schoolbus also heard and saw the train as the bus continued to approach the crossing. Several students shouted warnings to the busdriver.

At a point about 220 feet from the crossing, the bus momentarily decelerated but then resumed its initial speed. When the train was about 150 feet south of the crossing, the traincrew decided that the schoolbus was not going to stop, and the engineer applied the brakes in emergency. Just before the impact, the driver applied the schoolbus brakes.

The locomotive struck the middle of the right side of the schoolbus. Just after impact, the rear section of the bus was torn loose from the remainder of the body and roof. This rear section, with students still inside, was found in an inverted position on the west side of the track, 85 feet north of the impact point. The remainder of the bus was pushed broadside ahead of the train 1,116 feet down the track. (See Figure 2.)

Accident Site

This accident occurred on Gilchrist Road, near Congers, N. Y., at the intersection at grade with a single track of the Penn Central Railroad. Congers is located on the west side of the Hudson River, approximately 21 miles north-northwest of the George Washington Bridge.

At the grade crossing, Gilchrist Road runs east and west and is 29 feet 3 inches wide. At the same location, the railroad right-of-way is 81 feet wide. The track, of standard construction, runs north and south.

[1]Appendix A describes in detail the visibility at the grade crossing on the morning of the accident.

Eastbound traffic on Gilchrist Road was regulated by a standard stop sign located 5 feet south of the southern curb and 58.5 feet west of the center of the track. Mounted directly below this sign was a standard railroad-crossing advance-warning sign. In addition, "STOP" was lettered in white paint across the eastbound lane of the road. The letters, 7.5 feet from top to bottom, were located 33.5 feet west of the center of the track. (See Figure 3.)

Six feet south of the southern curb of Gilchrist Road and 16.5 feet west of the center of the track was an upright post which, in the past, supported a railroad crossbuck. After the accident, the crossbuck was found lying on the ground some distance from the post.

Although westbound traffic was restricted to 15 m.p.h. by a posted sign, the eastbound lane was not so posted. When not posted, the legal speed limit was 30 m.p.h., conditions permitting.

A daily-traffic count conducted from April 7 through April 11, 1972, revealed an average of 451 eastbound and 452 westbound vehicles daily. However, since many sightseers were still coming to view the accident site, the count may be invalid.

During March 1972, eight freight trains in each direction were run daily on the railroad track. Each day, one train crossed Gilchrist Road between the hours of 7 and 8 a.m.

Environmental Factors

On the morning of the accident, the sky was clear, and the sun was shining. The road and track surfaces were dry. The temperature was 42° F., and a slight breeze was blowing from the north.

The sun was 22° above the horizon, 18° south of east. Since the schoolbus involved in this accident was traveling due east, the sun was 18° to the driver's right. Although the sun glare to the south of the bus may have created a slight annoyance for the driver, it was not sufficient to interfere with his view of an approaching northbound train. Because of the construction of the bus windshield header, the vertical angle of the sun exceeded the vertical vision angle of the busdriver.

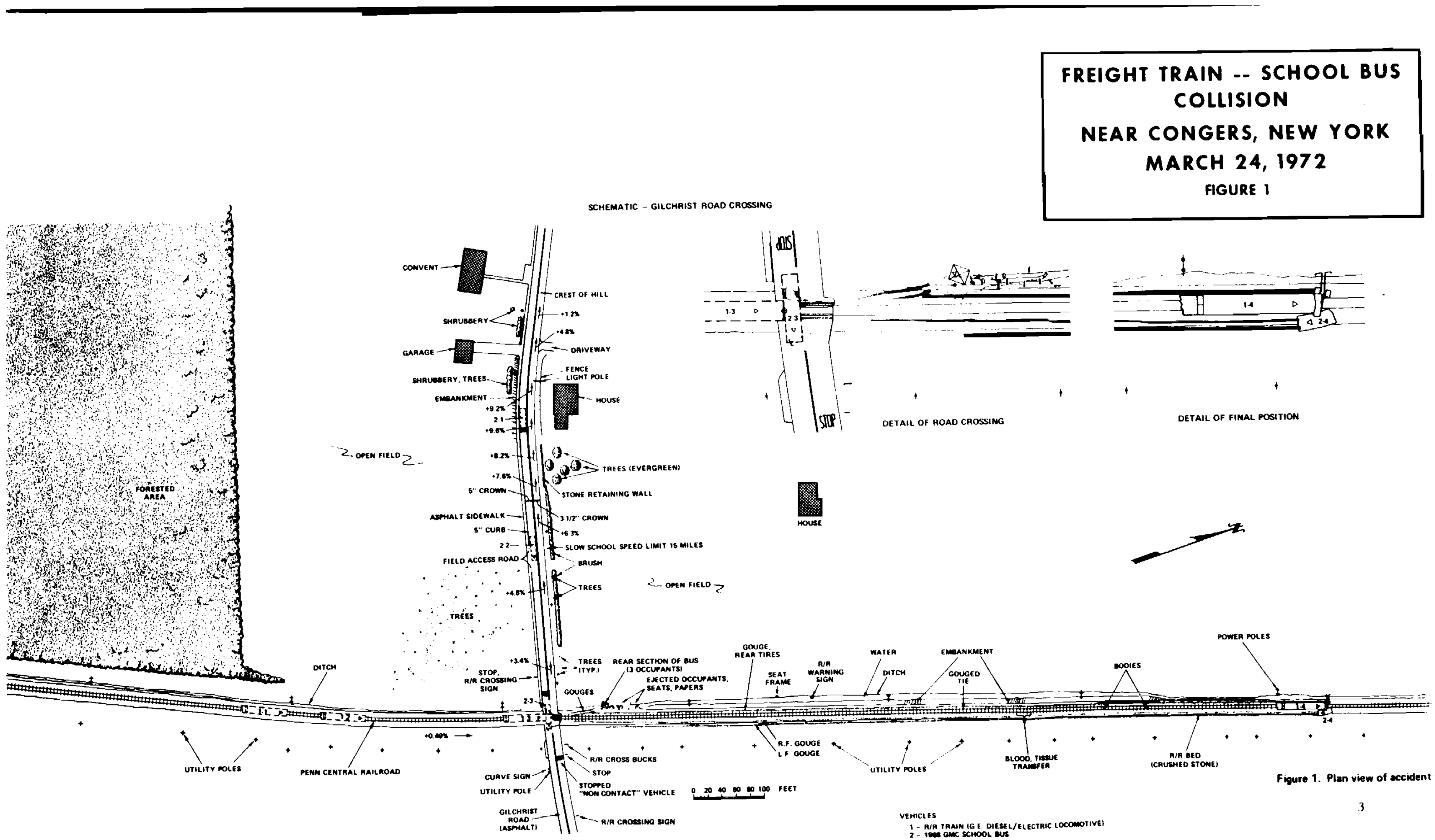

Figure 1. Plan view of accident

Figure 2. Final position of schoolbus and lead locomotive.

Figure 3. Traffic control devices on the eastbound approach to the Gilchrist Road Crossing.

A small stand of trees was located south of the eastbound approach to the crossing. Since on the morning of the accident, these trees were devoid of foliage, they did not significantly obstruct the vision of an eastbound driver.

Marks on the Roadway

After the accident, several tiremarks were found at the grade crossing. (See Figure 4.) On the west side of the west rail was a pair of marks made by dual tires. The right tire marks started about 13 feet 5 inches west of the rail, continued due east for about 3 feet 2 inches, and then shifted in a northerly direction. The left tire mark was one foot long and parallel to the pattern of the right tire marks.

These three marks west of the track appeared to have been caused by sliding of tires. The right tire skid began at a point 4 feet 8 inches north of the southern edge of Gilchrist Road and blended into the left tire mark. The marks extended to the northern edge of the pavement, a distance of about 18 feet, and then faded out.

On the east side of the east rail was a single tire scuff mark. This mark started at a point 13 feet 6 inches east of the rail and followed a curved pattern to the northern edge of Gilchrist Road.

Postcrash Activities

Rescue services. The Clarkstown Police Department received notification of the accident at 7:56 a.m., and alerted the central control post for the local ambulance corps.

The train crew exited the locomotive as soon as it came to a stop. The fireman went to the third engine to radio in a report of the accident. The engineer and the brakeman immediately went to the bus and helped with the extrication of passengers. The traincrew was joined in the rescue effort by several nearby residents.

Several of the less injured passengers, who had evacuated the bus without assistance through the window openings and windshield space, also helped to extricate their fellow students.

The injuries of the driver precluded his taking a role in first-aid and evacuation procedures. Although it was reported that the driver was not using the available lap belt, the nature of his injuries and his position in the bus at the time of rescue suggest that had he been belted, he nevertheless would have sustained disabling injuries.

Several bystanders immediately began administering first aid to injured passengers before the first police vehicle arrived at 7:58 a.m. The

a. West of the track.

b. East of the track.

Figure 4. Tire marks on Gilchrist Road after the accident.

officers immediately radioed for additional personnel and ambulances. Ambulance requests were directed to units in Congers and several neighboring communities.

Congers Fire Department apparatus and several more police vehicles arrived, and the rescue was well underway within 20 minutes after the collision.

Emergency medical services. At 8:00, the police notified Nyack Hospital of the accident. The call arrived as night-shift personnel were reporting off duty and the day shift was reporting in. All personnel were held on duty to receive and treat the injured. A physician and three nurses were immediately dispatched to the scene, and a hospital disaster plan which had been rehearsed on January 30 was implemented. The chief of surgery was notified and reported to the hospital. He supervised the preparation of disaster units and the readying of all surgical units. An empty wing of the hospital was immediately made available for the victims.

The physician sent to the accident conducted a preliminary triage (medical evaluation) and advised the hospital on the number of casualties, and the nature and severity of the injuries. Other physicians arrived and assisted in extrication, treatment, and evacuation of the injured. Many of the students who had minor injuries traveled to the hospital via police vehicles. The last student was transported from the scene approximately 55 minutes after the collision.

Bus salvage. A tractor with a backhoe was used to extricate students pinned between the locomotive and outer wall of the schoolbus. After this was completed, a fire truck sprayed the forward section of the bus with foam to prevent fuel ignition. The bus chassis was cut at its approximate center and was pulled from the track by the backhoe. The rear section of the bus body and all seats and smaller components were loaded into a dump truck. The remaining chassis and forward body section of the bus (see Figure 5) were loaded onto a "lowboy" semitrailer. All parts and components of the bus were then removed to a nearby New York State Department of Transportation facility.

Vehicles and Vehicle Occupants

The schoolbus. The schoolbus involved in this accident was a 66-passenger 1967 Carpenter body mounted on a 1968 General Motors Coach frame. Detailed specifications for this bus can be found in Appendix B.

Schoolbus driver. The busdriver was a male, 37 years of age, 5 feet 10 inches tall, weighing 185 pounds. His primary employment was with the New York City Fire Department. As a fireman, his duties did not include the operation of any departmental vehicles.

The busdriver had been driving a schoolbus for Rockland Bus Lines since 1966 on the same general route. His driving behavior was described by bus passengers (both those present on the day of the accident and those who were not involved in the accident) as ranging from "average" to "unacceptable." His driving record with the State of New York included two property-damage accidents while driving a schoolbus, but no traffic violations.

The driver's medical history is unknown. Although an annual medical examination is required by the New York State Department of Education for schoolbus drivers and the Rockland Bus Lines had a physician selected for that purpose, no record of any examination of this driver was found during the Safety Board's investigation. The bus company claimed they could not find any such record.

The driver usually left the garage at 7:30 a.m., and returned at around 8:25 a.m. He then drove to a firehouse in New York City, 30 miles from the bus garage. His tour of duty with the Fire Department on the day of the accident was scheduled to begin at 9 a.m.

The schoolbus driver, acting on the advice of his attorney, refused to discuss the details of the accident. He was excused from appearing as a witness at the Board's public hearing because of a doctor's statement of impairment of health. He was subsequently charged by the State of New York with five counts of criminal negligence as a result of this accident. Because of the pendency of these charges, the busdriver declined to answer a series of questions submitted to him subsequent to the hearing by the Safety

Figure 5. View of the schoolbus after rescue operations were completed.

Board. On March 8, 1973, the driver was convicted on all counts.

Schoolbus passengers. The position of the busdriver and the 49 passengers before the accident and the severity of their injuries are shown in Figure 6. A detailed description of the injuries suffered by each occupant of the bus can be found in Appendix C.

The freight train. Penn Central freight train WV-1 was operating with three diesel-electric locomotive units, 83 freight cars, and a caboose. The gross tonnage of the train was 4,230 tons.

The lead locomotive unit was a General Electric, Model U-25-B, general-purpose type equipment. The unit had a fixed dual-sealed beam, white headlight mounted near the top of the cab and was equipped with airbrakes and an air-operated 3-chime horn and bell. Two of the horn chimes were facing forward, and one was facing to the rear.

The locomotive was painted Brunswick green, a color which appears to be almost black. There was no speed-recording device on the train, and the speedometer was inoperative. A more complete description of this unit can be found in Appendix B.

The crew of the train. The crew included an engineer, a fireman, and a brakeman, all riding in the lead locomotive cab, and a conductor and a flagman in the caboose. All crewmembers were qualified in accordance with Penn Central rules and were in compliance with the requirements of the Federal Railroad Administration hours-of-service regulation. No members of the traincrew were injured in this collision.

Vehicle Damage

Schoolbus. When the schoolbus was last inspected before the accident on February 16, 1972, it was found to be in good condition. A summary of that inspection, required by the State of New York, can be found in Appendix B.

Although the bus was destroyed, a mechanical inspection of components critical to safe operation was possible. This inspection, conducted the day after the accident, revealed no mechanical defects. (See Appendix B.)

It was possible to ascertain most of the accident-induced damage from photographs, witnesses' statements, and a postcrash examination of the remains of the bus. That damage was as follows:

- The chassis frame was bowed and buckled to the left (facing from the back to the front of the bus). The right-side rail was bent at three distinct locations (near the driver's station, at the point where it was struck by the locomotive, and rearward of the rear axle). The roof separated from the left sidewall, was peeled back as a unit from left to right, and was wrapped around the front of the locomotive.
- All of the left window columns separated at the roof line as did several of the right columns.
- A 102-inch-long rear section of the bus body, comprised of the last four rows of seats, was separated from the rest of the body at a riveted joint above the rear wheelwell. (See Figure 7.) The rear-section sidewalls and floor panel were intact, but the roof was torn off. The window columns were collapsed almost to the top of the seat backs.
- The rear section was separated from the chassis frame at the body mounts.
- In the remaining forward section of the bus, all exterior sheet metal side panels were damaged.
- The floor panels buckled throughout the bus. The panel supporting the seats in row six separated from the panel supporting the seats in row seven, which left an opening. (See Figure 8.)
- Most of the seat anchorages separated or partially separated from the floor. Although some of these seats may have been removed during the rescue operation, witnesses indicated that most were torn free from the floor as a result of the crash. In most separations the mounting bolt heads pulled through the floor panels and the bolts did not shear.

INJURY SEVERITY ACCORDING TO OCCUPANT SEATING POSITION

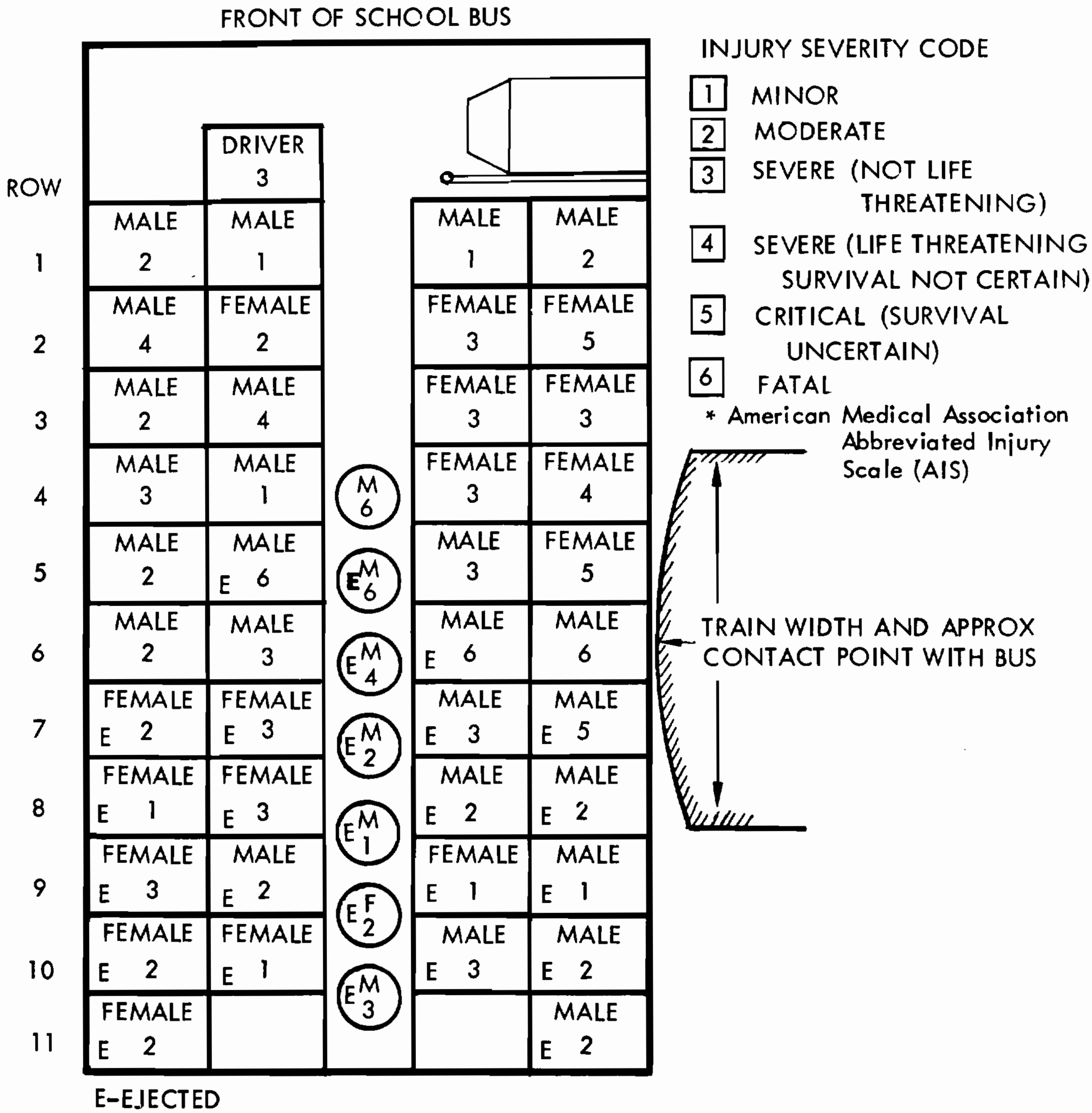

Figure 6. Precrash position of bus occupants and severity of each occupant's injuries.

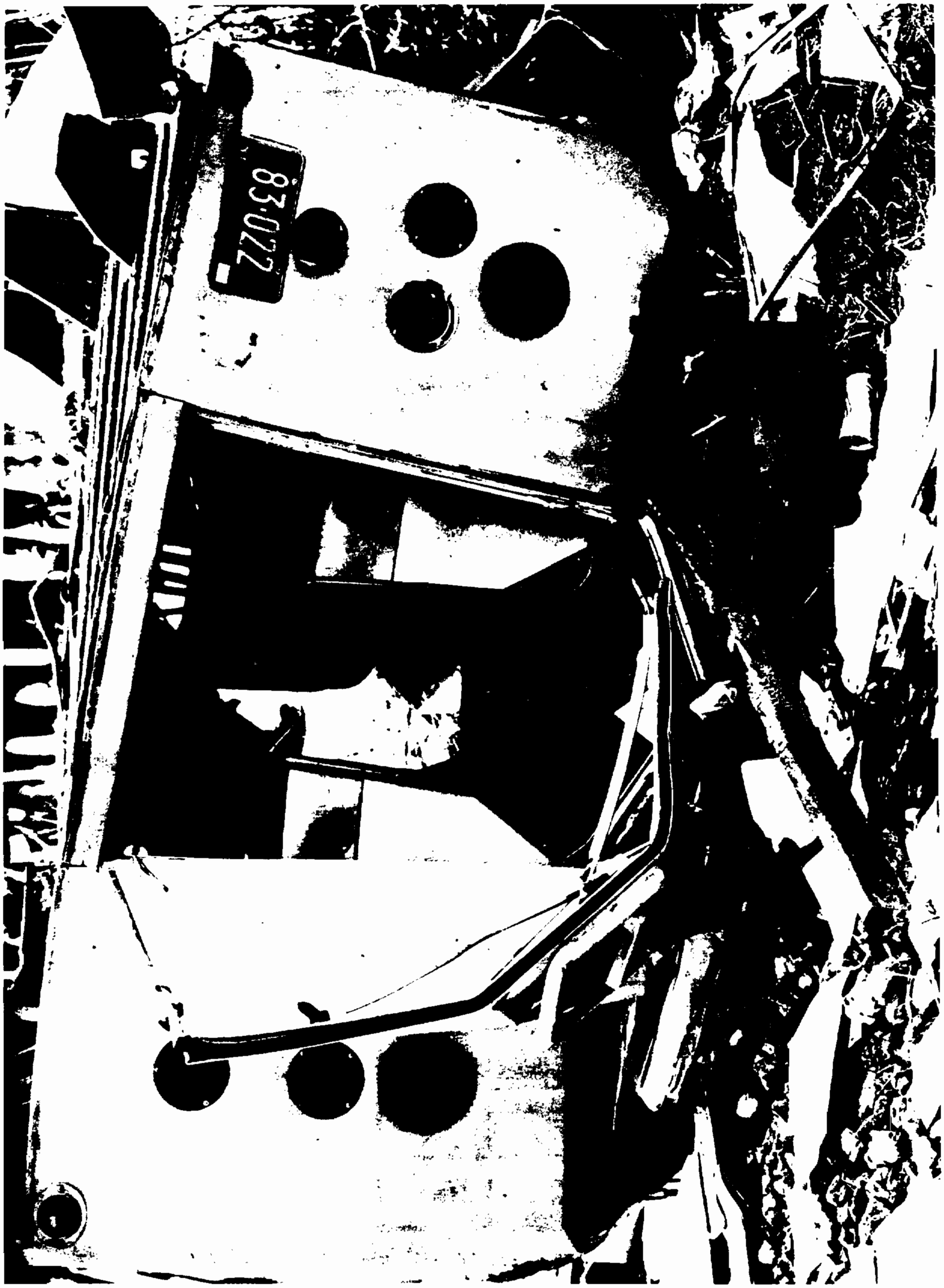

Figure 7. Rear section of schoolbus at final resting position.

Figure 8. Crash damage to the interior and side walls of the schoolbus. Arrows point to exposed metal edges on the right sidewall.

- Both left and right interior side panels were severely buckled. The right side panel separated at joints just to the rear of the door and between the fifth and sixth row of seats. The floor sections between those two points were detached from the side panels.
- All side window glass was shattered or broken out. The windshield was completely separated from its gasket mounting.

Freight train. A pretrip inspection by the crew at 6:59 a.m. revealed no malfunctions or deficiencies in the equipment. An inspection of the train conducted several hours after the collision revealed no mechanical defects. A summary of that inspection can be found in Appendix B.

Exterior damage to the lead locomotive was relatively minor. (See Figure 9.) None of the interior components of the locomotive incurred any permanent damage.

Accident and Enforcement Experience at the Crossing

There are no official records of any previous highway/railroad accidents at the Gilchrist Road crossing. Furthermore, the Town of Clarkstown Police Department has no record of any enforcement action for violation of the stop signs located at the Gilchrist crossing. A town police officer who regularly patrolled the area stated that he could not recall observing any violations at either of the stop signs at the accident site.

Testimony from bus passengers, however, revealed that the busdriver involved in this accident on occasions failed to make the required stop and more than occasionally just made a perfunctory stop. The busdriver's failure to come to a full stop was not unique. On several occasions just days after the accident, Safety Board investigators saw a number of vehicles, in both directions of travel across the track, fail to make the required stop.

The Safety Board has previously noted the lack of adequate enforcement at grade crossings which were specially protected by active devices such as gates, flasher lights, warning bells, or watchmen.[2] Although data on enforcement at crossings where only stop signs are installed are limited, it is probable that enforcement at these crossings is equally lax.

Pupil-Transportation System

Almost 2.1 million children (48 percent of the total student population) are bused each day to and from schools in the State of New York. This movement of students involves 755 school districts, of which 60 percent operate their own system and 40 percent use bus contractors.

The Bureau of Special Education Management Services in the State Department of Education has primary administrative responsibility for pupil transportation. The Bureau exercises broad general controls over district pupil-transportation programs and provides minimal service through two full-time staff members. Each individual district administers its own system.

The schoolbus involved in this accident was operating under the authority of the Union Free School District Number 4 for the purpose of transporting pupils to and from Nyack High School in Nyack, N. Y. (This district and seven other similar school districts comprise the public-education system in Rockland County.) During the school year 1971-1972, 2100 of the 3700 pupils in this district were transported by bus on a daily basis.

The Superintendent of Buildings, Grounds, and Transportation (hereafter called the district transportation supervisor) was delegated the primary responsibility of supervision of pupil transportation within the district. He had held that position for about 8 years.

The duties of the district transportation supervisor included the selection of schoolbus routes, scheduling of schoolbuses, assignment of pupils to schoolbuses, and liaison with the

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[2]National Transportation Safety Board, Illinois Central Company Train Collision with Gasoline Truck at South Second Street Grade Crossing, Loda, Illinois, January 24, 1970, NTSB-RHR-71-1; and Southern Pacific Railroad Company, Fruitridge Road Grade Crossing, Sacramento, California, February 22, 1967, public release January 15, 1968.

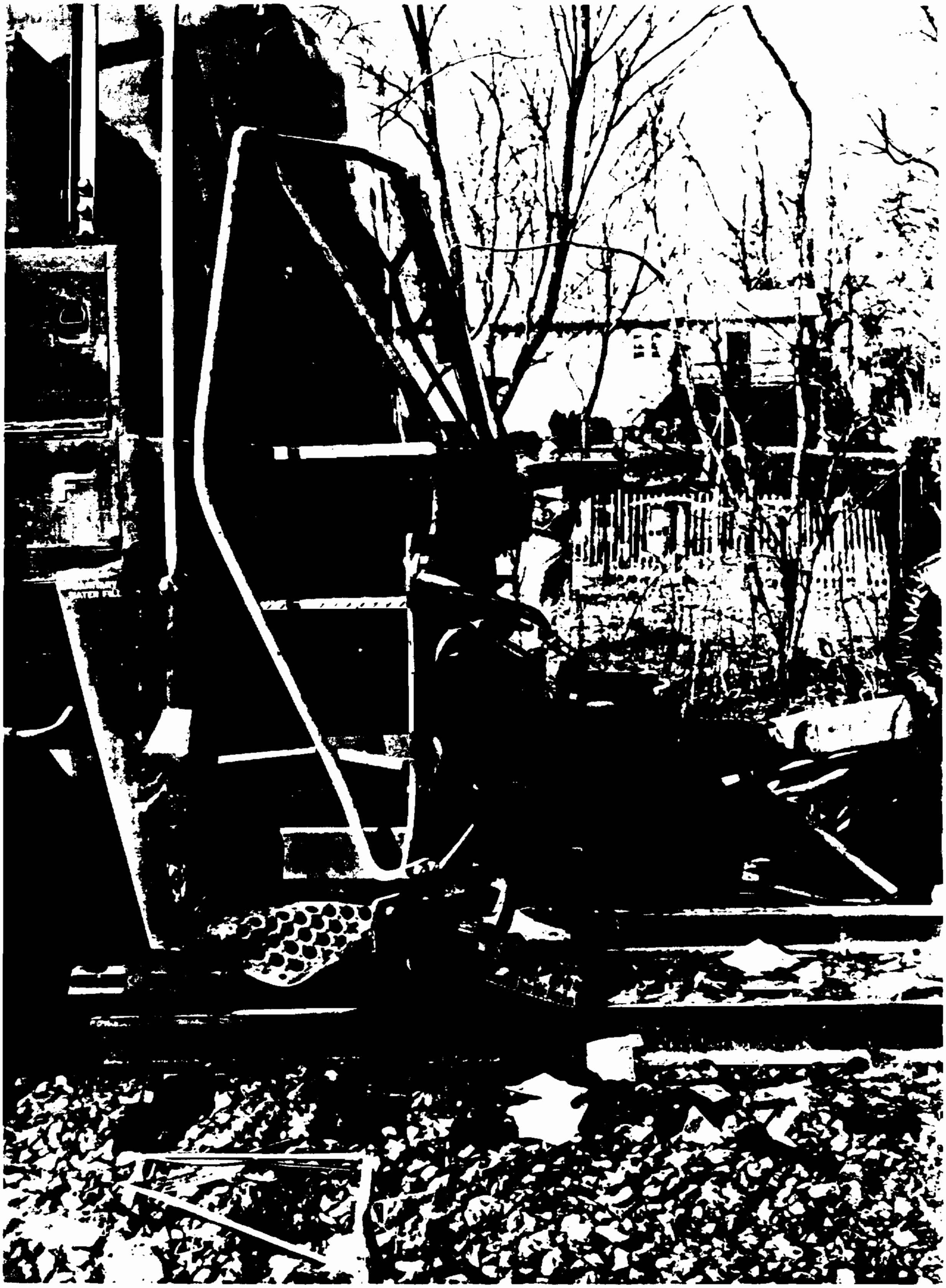

Figure 9. Damage to lead locomotive. Note the position of the coupler.

bus contractor. His major decisions relating to those functions were subject to consultation with and evaluation by both the business manager of the district and the Superintendent of Schools. Twenty-five percent of his on-duty time was expended in carrying out his pupil transportation responsibilities.

The district transportation supervisor had had no formal training in pupil transportation and had not completed any formal academic preparation for the responsibility.

Selection of schoolbus routes. No written standards or procedures had been promulgated by the district to guide the transportation supervisor in the design of schoolbus routes. He usually selected routes by surveying a map of the locale and relying on his personal knowledge of the characteristics of the area to be served.

In this route-design process, there was little, if any, consultation with local highway and police officials. Such consultation, along with field inspection of prospective routes, was recommended by the 1970 National Conference of School Transportation, sponsored by the National Education Association.[3] Inspection trips for all roads which may be included in a route under consideration are also recommended by the State Department of Education.[4]

The route scheduled for the bus was approved by the business manager of the district, the general manager of the busline, and the Superintendent of Schools. This route was put into operation 3 to 4 years prior to the accident. There was no field inspection of the route by the district transportation supervisor at that time, nor was there a follow-up survey. When selecting the route, the district transportation supervisor was aware of the presence of the railroad/highway grade crossing at Gilchrist Road.[5]

Contractual arrangements with Rockland Bus Lines. The contract between Rockland Bus Lines (the contractor) and the district specified that a total of 25 60- and 66-passenger buses were to be provided for a minimum of two trips each in the morning and in the afternoon.

Generally, the maximum number of students assigned per bus was 55. This number was without regard to the grade level or physical stature of the students. There were 55 high-school students assigned to the bus involved in this accident. Just before the collision 42 were occupying seats, and 7 were standing in the aisle.

Selection of schoolbus drivers. The contractor employs about 66 drivers, who are selected for employment by the busline's general manager and hired as part-time employees. Many are also full-time employees in other occupations. Although the contractor was aware that the driver involved in this accident was employed full-time as a fireman, there was no indication that the driver's hours of duty in that position were considered other than to ascertain if he was available to drive the bus at the time required.

Schoolbus-driver qualifications prescribed by the Commissioner of Education of the State of New York were reiterated in the contract signed by both the district and the contractor. The contract specifies that the contractor shall "secure and submit" to the Superintendent of Schools information to show that all drivers meet all State requirements. This provision reportedly is met through submission of completed contractor employment applications to the district.

In prescribing the driver requirements which must be met, the contract stipulates that the contractor shall present information to show that all drivers:

> "Be of good moral character and thoroughly reliable; his character and reliability to have been attested to by three character references other than em-

[3]Standards for Schoolbus Operation, National Commission on Safety Education, National Education Association, Washington, D. C., 1970, pages 21-24.

[4]Transportation - School Business Management Handbook, University of the State of New York, Albany, N. Y., 1971, p 16.

[5]This route was changed by district officials soon after the collision. Passengers formerly assigned to this route who were picked up on the east side of the crossing have been assigned to another bus. Routings used by the Nyack District now avoid traversing railroad/highway grade crossings not specifically protected.

ployer or relatives. Specifically, information will be solicited concerning moral character, tactfulness, offenses against the law, convictions, and temperance. (Contract specification 5(a)(4))

Because it does not request the names of persons who could have attested to the applicant's character, the employment application form used by the driver involved in this accident does not satisfy specification 5(a)(4).

The contractor checks the moral character and driving background of applicant drivers through the local police and the New York State Department of Motor Vehicles. A letter of reference is also generally sent to the applicant's full-time employer, although no such letter was sent to the New York City Fire Department regarding the driver in this accident. Fingerprinting of applicants was not a part of the selection process.

Licensing of schoolbus drivers. New York State law requires that schoolbus drivers possess a Class 2 Chauffeur's License. In order to be eligible for the road test, a candidate must successfully complete a preservice training course. This course, which may be conducted by the candidate's employer, should consist of 6 hours of classroom instruction and 40 hours of on-the-road training. A basic 20-hour course of classroom instruction outlined by the State Department of Education is recommended but is not mandatory. The road test may also be administered by the candidate's employer. Successful completion of that part of the licensing process is certified by the examiner (in this case, the contractor's general manager) on an official State form. Upon receipt of this form, the State Department of Motor Vehicles issues a Class 2 Chauffeur's License to the candidate.

These licensing provisions were in effect in 1966, when the busdriver secured a Class 2 Chauffeur's license. The license that the driver held at the time of the accident was a renewal issued in 1969.

In-service training for schoolbus drivers. Although there was no requirement by law, the contractor conducted periodic in-service training sessions for all drivers. Drivers were expected to attend; however, attendance records were not kept. There was no evidence that the driver involved in this accident attended any of the sessions.

The training sessions usually consisted of visual presentations accompanied by safety lectures. This training program, as well as the one on preservice training, was administered by the contractor without any participation by school officials.

An in-service training session held on the day before the accident included a discussion of the busline's unwritten policy concerning all railroad/highway grade crossings. That policy requires that drivers stop at all grade crossings at a point no closer than 15 feet and no farther than 50 feet and open the door to ascertain track clearance prior to proceeding through the intersection.

Supervision of schoolbus drivers. The contractor used the service of the parent company's safety supervisor to evaluate the on-the-job driving behavior of schoolbus drivers. This function was accomplished on a periodic, but unscheduled, basis through the use of an unmarked car. There is no evidence to indicate that the driver involved in this accident was ever evaluated on the road by the safety supervisor.

In addition to this type of safety supervision, the general manager occasionally rode in the bus with drivers while they were actually engaged in passenger runs. The general manager stated that he had ridden with this driver and had noted no adverse driving behavior.

The transportation supervisor did not participate in safety supervision.

Handling of complaints against schoolbus drivers. Although at least one parent of a regular passenger of the schoolbus involved in this accident had complained to a district administrator concerning an incident in which the driver drove in an unsafe manner, there is no record to indicate what action, if any, was taken as a result of that complaint. Neither the contractor nor the district had a formal complaint reporting-and-review system to record such information.

Applicable Laws, Regulations, Operating Rules, and Standards

New York vehicle and traffic laws. Section 1685 of the New York State Vehicle and Traffic Law confers upon local road and state highway departments the authority to erect stop signs at highway/railroad grade crossings within their respective jurisdictions.[6]

Traffic control devices in New York are located in conformance with the New York State Manual of Traffic Control Devices. The placement of railroad advance-warning signs underneath stop signs is not prohibited by the manual. The manual, however, does recommend that such warning signs be placed 300 feet before a crossing.

Section 1171(a) of the Vehicle and Traffic Law, which governs the movement of schoolbuses at grade crossings, requires that drivers: ". . . before crossing at grade any track or tracks of a railroad shall stop such vehicle within fifty feet but not less than fifteen 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. . ."

Section 160(b) of the Vehicle and Traffic Law provides that each schoolbus shall be equipped with a seatbelt at the driver's position. Section 383(a)(4) requires the schoolbus driver to use the seatbelt.

New York pupil-transportation regulations. The State Department of Education is empowered to adopt reasonable standards governing the administration and operation of pupil-transportation systems throughout the state. A publication entitled, **Education Law - Handbook for School Boards**, was distributed to all school districts by the New York School Board Association. This booklet contains a chapter on transportation, which includes explanations of many of the regulations and standards which are relevant to pupil transportation safety.

[6]The installation of stop signs at grade crossings is authorized by law in 43 states. The provisions of those laws vary slightly from state to state, primarily in regard to installation authority and location of the stop signs. Enforcement provisions of the laws are similar in that they provide for penalties to be assessed against those who fail to comply with the stop provision of the sign.

Because it would be impractical to note all the controls provided by the State, only those which might be relevant to this accident are listed below:

- Contractual arrangements between districts and schoolbus contractors.
- Minimum standards for the selection of drivers, including instructional material for the training of schoolbus drivers.
- Periodic training of students in bus emergency evacuation procedures.
- Forms and other business management practices to be used in the administration of pupil transportation.

Federal standards. Federal Highway Safety Program Standard No. 17, "Pupil Transportation Safety," sets minimum requirements for equipment, maintenance of equipment, selection, training, and supervision of drivers and maintenance personnel, and administrative provisions in the field of pupil transportation.

Operating rules of the railroad. Penn Central Transportation Company rules require the whistle (horn) of all trains to be sounded when the train approaches any public crossing. The prescribed sequence is two longs, one short, and one long. The signal is to be prolonged or repeated until the crossing is reached, unless otherwise provided. Penn Central operating rule 17 requires headlights to be brightly displayed to the front of every train at all times.

There are no corresponding Federal regulations or Federal authority.

III. ANALYSIS

Operation of the Schoolbus

Since no mechanical malfunctions were found on the schoolbus, the general question to be analyzed is the reason the bus was driven onto the track into the path of an approaching train.

The visibility available to the driver was unobstructed and more than adequate. Several occupants of the bus saw the train as far as 600 feet from the crossing. The busdriver, however, made no overt movement at any time which can be interpreted as an indication that he observed the train prior to reaching the immediate vicinity of the track.

The audibility of the locomotive horn as the bus approached the crossing was evidenced by the fact that several passengers in the bus and a witness near the crossing clearly heard the signal throughout the train's approach to the crossing. There was no action on the part of the schoolbus driver which would suggest either that he did not hear the horn or that he heard the horn and chose to ignore it. Because of this lack of response, the possibility of physical or mental incapacitation must be considered.

No evidence was made available to document the busdriver's hearing ability. However, the busdriver's continuous employment as a fireman (a position which requires an adequate physical condition) suggests that his hearing was not defective. It is possible that he failed to regard the horn as a warning. Such a failure could have been precipitated by an expectation that no train would be encountered at this crossing, based on longtime experience.

Although there was a momentary deceleration of the bus some distance before it reached the stop sign, this deceleration did not bring the bus to a stop at the sign. An explanation of the almost immediate resumption of speed could be that the driver observed the train and made a decision to continue ahead in anticipation of passing safely in front of it. That decision might have been based on a misperception of the train's speed and distance from the crossing, along with the realization by the busdriver that because of the detour, he obviously would be late reporting to his primary place of employment if he should have to wait for a freight train to clear the crossing. The application of the bus brakes just prior to impact raises the possibility that the busdriver belatedly recognized the danger.

A review of the busdriver's workday routine revealed that he usually returned to the bus garage at 8:25 a.m. On the days he worked as a fireman, he then drove 30 miles in rush-hour traffic to reach the firehouse. A test run made between the garage and firehouse, with the test driver complying with all the traffic regulations and following the best available route, indicated a minimum travel time of 1 hour 5 minutes. The schoolbus driver thus would not have been able to arrive at the firehouse at 9 a.m. on any day that he drove the schoolbus.

There was no standard, rule, or regulation to require employers in New York to examine the hours of primary employment of their schoolbus drivers to determine to what extent their schedule might cause them to hurry to complete their routes or affect their safety performance in any other way. This driver's work schedule was not considered by either the contractor or school administrators.

Effect of the Road Signs

Although this was the first known approach by the busdriver to the tracks from the east instead of the west, he was nevertheless quite familiar with the area. He had been driving a schoolbus in this vicinity for 6 years and knew the location of the track. Had the advance warning sign been more appropriately posted and had the crossbuck been in place, the driver's visual attention could have been attracted at three separate locations on his approach to the crossing. In addition, such signing could also have served as a warning to the driver that his passengers would be aware of his failure to heed the hazard message if he should opt to ignore it.

There is considerable controversy about the effectiveness of highway stop signs used at grade crossings in lieu of other protective devices. Proponents for the placement of such signs usually state that:

- Motorists are more familiar with highway stop signs than grade-crossing protective devices; experience has conditioned them for the dangers of failing to stop.
- Stop signs stimulate motorists to exercise caution at all times when they are approaching grade crossings. Grade-crossing protective devices remind them of potential danger only when a train is near, or on, the crossing.

On the other hand, two of the most often stated objections are that:

- Motorists tend to disobey stop signs at highway/railroad grade crossings more than at highway intersections. When there is observance, it is usually only a rolling stop or slowing down of the vehicle. Occasionally, motorists develop contempt for stop signs as a result of encounters at little-used crossings and unconsciously carry over that contempt by not stopping for signs at highway intersections.

Operation of the Train

The train was traveling at approximately 37 feet per second (25 m.p.h.) when the crew first noticed the schoolbus approaching the crossing. Although the bus was kept in sight, the speed of the train was not reduced. The engineer made an emergency application of the train brakes only when it became apparent to the crew that the bus might not stop at the track.

Although the exact point of brake application is not known, application anywhere close to the estimated location (150 feet from the crossing) would have had no appreciable deceleration effect on a train of that consist. That the distance required for effective braking was much greater than the distance available to this train is demonstrated by the distance traveled by the train after impact.

The dark green color of the locomotive could cause it to blend into a background of similar color.

Crash Events

Impact forces were sufficient to stop the eastbound momentum of the schoolbus and to accelerate the bus to the velocity of the train.

The coupler of the lead locomotive immediately penetrated the outer wall of the bus and contacted floor panels, which buckled under the forces and began to separate. The right side of the bus then began to lift upward, and the floor panels overrode the coupler. That positioning allowed the locomotive to support a portion of the weight of the bus and the coupler to penetrate further inboard. After the coupler made contact with the right chassis member, the bus was literally locked to the train as it buckled into a "U" shape and wrapped around the locomotive.

The resultant decrease in the resistance of the bus to lateral movement probably prevented the locomotive from slicing through the midsection of the bus. The bending of the bus in the middle absorbed some of the energy and created relatively reduced accelerations in the front and rear sections of the vehicle. Had these events not occurred, the injuries might have been much more severe.

It is more likely, however, that had the bus been deflected soon after impact rather than subjected to 1,116 feet of oscillating lateral travel, structural disintegration would not have been as severe.

The protruding coupler was not necessary for the operation of the locomotive on the mainline. Although the coupler is important in yard operations, it is nothing more than an occasional convenience in mainline operation. There are practical means of covering the coupler to present a configuration with greater deflective qualities. Future locomotive designs could reduce one source of collision damage through recessing the front-end coupler, as provided on passenger train locomotives. Indeed, the Federal Railroad Administration, in response to a Safety Board recommendation,[7] had instituted a research project to investigate the feasibility of locomotive impact-attenuation devices.

Just prior to the impact, many of the passengers attempted to avoid the contact area by standing up and moving to the back, left side or front of the bus. Consequently, many of the students came to rest several rows away from their original positions. Many of those interviewed could describe their body movements as "going over and over," "spinning around," and "like flying for a split second." The preimpact directions of travel of both vehicles and some definite injury contact points indicate that the occupants moved forward and to the right.

Several occupants struck the seats to the front of them and side panels. Many of the seat anchorages failed at impact. Several students who remained with the forward section of the bus were piled together with interior

[7]NTSB Safety Recommendation to the Secretary of Transportation, April 25, 1969.

of the bus.

Five passengers who were standing in the aisle of the rear section of the bus moved rearward towards the emergency door to escape the crash. This movement occurred almost immediately prior to the bus entering the crossing.

After making contact with the ground, 34 feet north of the impact point, the separated rear section slid in a northerly direction for approximately 50 feet before a distorted piece of metal on the right front corner embedded in the dirt and caused the section to vault forward, turn over, and come to rest on the still-intact window columns, which then collapsed.

Approximately 23 passengers were located in the rear section when it separated from the remainder of the bus. It has been estimated that five or six of those passengers, who were probably closest to the area of separation, were ejected to the rail bed on the west side of the track. Several passengers definitely recall such movements. The remainder of the passengers stayed with the rear section until it came to rest.

The collapse of the window columns in the rear section, after it came to rest on its top, resulted in crushing and compression-type injuries.

After the bus was accelerated to the speed of the train, the forward section still locked to the locomotive, began to disintegrate. This break-up of the bus contributed to the severity of the injuries.

The separation of the buckled floor section left a large opening. Two students fell through this opening onto the track into the path of the train. The probable points of ejection were marked by transfers of blood and tissue which began 670 feet north of the point of impact.

Two other passengers were also ejected from the forward section. They were pinned between the exterior of the bus (near the front door) and the right front corner of the locomotive. They could have worked their way out the door as the front section of the bus oscillated down the track. One suffered only minor injuries, but the second incurred critical injuries and died three days later.

mained in the bus. These students were in the immediate area where the locomotive made contact with the bus, as were two passengers who suffered amputations.

The Safety Board has long been on record, in the form of formal safety recommendations, in seeking improved schoolbus body structural integrity. In addition, the National Conference on Schoolbus Transportation[8] has published standards and the Vehicle Equipment Safety Commission[9] has published specifications (VESC-6) pertaining to schoolbus construction and equipment needed for safe pupil transportation. Those specifications have been adopted completely or in part by 12 States.

The National Highway Traffic Safety Administration (NHTSA), in their report of a schoolbus accident at Monarch Pass, Colo., cited schoolbus-body inadequacies to which the Safety Board and others have previously addressed themselves.[10] The NHTSA report states that "a definite injury severity increasing factor was a lack of structural integrity in the roof and sidewall area of the bus." Other possible injury-producing factors listed were "seat attachments . . . inadequately designed," "lack of resistance to localized penetration," and "separation of interior roof panels." The facts in this accident reveal essentially the same conditions.

Injury-Production Analysis

Due to the extreme damage suffered by the bus, it was impossible except in a few instances to correlate occupant injuries precisely with contact points. However, injuries were produced within the bus and most likely occurred when passengers struck the following:

[8]National Conference on School Transportation, Minimum Standards for School Buses, 1970 revised edition, National Education Association.

[9]Vehicle Equipment Safety Commission, Regulation VESC-6, Minimum Requirements for School Bus Construction and Equipment, Washington, D. C.

[10]National Highway Traffic Safety Administration, Monarch Pass, Colorado, School Bus Crash, March 1972, Washington, D. C.

- exposed seat-frame rails
- broken seats
- unpadded grab rails
- sharp edges of separated side panels
- broken window frames and flying glass

Most of the lacerations were probably produced by exposed sharp metal edges such as window-frame rods and separated body panels. Obviously, the more panels that separate, the greater the probability of lacerative-type injuries. Improved fastenings could reduce this type of injury.

The greatest number of injuries occurred to the head. These injuries can be attributed to the tumbling movements of the passengers as they struck each other and interior components of the bus. Figure 10 shows exposed seat-frame rails which can cause head injuries. Also, seat cushions in crash situations become detached and exposed additional areas of metal framework. This condition not only increases the occurrence of head injuries, but also results in fractures of the arms and legs when those extremities become entangled in the framework. A highstress, well padded, highback seat that would retain its cushions and anchorage with the floor would prevent a significant number of such injuries. Such protection, especially for children, is important because disfiguring head and facial scars can have long-lasting effects on the development of their personalities as young adults.

Seatbelts. The availability of seatbelts in combination with padded highback seats of improved design would have reduced the injury severity in the following ways:

- Restraints would have prevented the ejections experienced in this accident.
- Restraints would have prevented the postimpact kinematics of the passengers.

This is especially true of the rear section that came to rest on its top.

It can be argued that if the passengers who were seated in the front section (primarily in the impact area) had been belted, they would not have been able to escape the crushing effect of the locomotive. Thus the possibility arises that these students, if belted, might have incurred more severe injuries.

On balance, however, unless unbelted passengers in the impact area are alerted to the impending collision in sufficient time to escape, it is probable that they will suffer severe injury in any case. Furthermore, the use of seatbelts would obviously be useful to the majority (those located outside of the immediate impact area) of schoolbus passengers.

The use of seatbelts as a restraint system on schoolbuses has been a controversial issue. The National Highway Traffic Safety Administration (NHTSA) has gone on record as opposing seatbelts in schoolbuses because of issues such as: (1) the probability that with present seats, a child's head would be targeted against an unyielding seat frame; (2) the problem of fitting seatbelts to a variable student population; (3) the number of seatbelts to install per seat; (4) the inadequacy of present seats to withstand forces that would result with belted occupants; (5) the unknown discipline problems; and (6) the willingness of the students to wear the belts. Those issues must be resolved.

The presence of standing passengers. Two of the seven standees in this bus were injured fatally, and each of the remaining five received some type of head injury. Although the New York State Department of Education does not prohibit standees on schoolbuses, it strongly recommends that every effort be made to provide a seat for each pupil.[11] The 66-passenger capacity of this bus might suggest that there was ample seating available for the 49 passengers who were in the bus at the time of the accident. That passenger-seating-capacity rating, however, is not practical when a bus is transporting high-school students. The average seat width allocation for each passenger in this bus was 13 inches, enough space for the seating of three grade-school students per seat, but somewhat cramped for the average-size high-school pupil. The seats on interstate buses are 38 inches wide and provide seating for two adults. The assignment of 55 high school students to such a bus, therefore, can result in a certain number of those passengers choosing to stand in the aisle.

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[11] See Footnote 5.

Figure 10. Interior of a schoolbus similar to the vehicle involved in the accident. Arrows point to injury-producting components.

The practice of permitting standees on schoolbuses is hazardous for the following reasons:

- The standing passenger is more likely to be propelled a greater distance in the bus in the event of a collision.
- The tumbling (or falling) standee becomes a projectile which can produce severe injury upon impact with other passengers.
- Emergency evacuation from the bus would be hampered by passengers in the aisle.

Compliance with the Federal Highway Safety Program Standard on Pupil Transportation Safety (Part IV C. 3. (2) "... avoid standees."), published soon after this accident, would eliminate such hazards.

Postcrash Activities

Although immediate treatment of the injured by local residents and the traincrew, and then by medical personnel on scene, prevented a greater loss of lives, the fact that the Nyack Hospital had an operational disaster plan and executed it efficiently was the most important single factor in effective care of the injured.

Pupil-Transportation System

Selection of schoolbus routes. Although not all unprotected crossings can be avoided. every attempt must be made to do so. If such crossings cannot be avoided, school and other local officials should make every effort to have them protected by active devices.

School administrators should develop and implement written policy guidelines for the selection of schoolbus routes. Such guidelines must include requirements for field inspection trips over prospective routes and meaningful consultation with local highway and police authorities.

Selection of schoolbus drivers. The schoolbus driver is the most important single safety factor during the operational phase of the pupil-transportation system. The qualifications for licensing of a schoolbus driver in New York do not meet the minimum standards set by the Federal government for commercial drivers in interstate commerce.

In those instances in which adequate standards for schoolbus drivers exist, they are not always complied with. This investigation revealed such instances in two important areas—character-reference check and annual physical examination.

Background information on driver applicants is helpful in the determination of attitudes and personality characteristics which might affect driving behavior and the ability to maintain rapport with children within a schoolbus environment. Although New York regulations require personal references through which such characteristics can be determined, the evidence suggests that neither the contractor nor the district complied with that requirement. In the absence of such information on this driver, his attitudes the personality characteristics (as they relate to this accident) cannot be ascertained.

For obvious reasons, the physical condition of schoolbus drivers is of paramount importance. Only through periodic evaluation by a physician can it be determined that a driver is free from organic or functional diseases which could interfere with safe driving. Such an examination was required annually by New York regulation, but the contractor failed to show that the requirement was met by the driver for this school year 1971-1972.

More important, however, is the absence of any provisions by this State to require the primary employment of part-time schoolbus drivers to be scrutinized. The importance of such a requirement is demonstrated by this accident.

Training of schoolbus drivers. Preservice and in-service training programs for schoolbus drivers are essential for the maintenance of high standards of safety. The programs should be continuous and provide for mandatory attendance.

The implementation of such programs in each independent school district (regardless of pupil population) would not always be practical. This suggests a need, therefore, for a statewide program, possibly administered and operated by a State agency, which would provide instruction for schoolbus drivers at the district level.

Such an effort has been initiated in the State of Arizona. That State, with the assistance of a Federal grant, has introduced a mobile schoolbus-driver trainer unit into its pupil-transportation system. This mobile unit, operated by the Traffic Safety Division of the Arizona Highway Department, is equipped with a multimedia teaching system. The portable classroom brings a comprehensive training program (both preservice and in-service) to the driver without cost to the school district. In addition to the quality instruction provided by this program, the State of Arizona reports that in the first year of operation the mobile classroom was used to train 810 of the 2,000 certified schoolbus drivers in that State.

Supervision of schoolbus drivers. The supervision of drivers by this company appears to be satisfactory. Such supervision, however, should also provide for a standard plan for periodic "check-rides," periodic written reports on individual drivers by the on-the-road supervisor, a complaint reporting and review procedure and record, intermittent evaluation of a driver's relationship with his passengers, and a continuing awareness of a driver's hours-of-duty with his primary employer and his other outside activities.

Management of the system. Expertise in pupil-transportation safety management was available through only two staff members of the Bureau of Special Education Management Services. Thus, it was possible to provide only minimal on-the-scene surveillance of and consultation with districts. Such services, with adequate staffing and funding, are needed to provide local districts with assistance in all phases of the management of their pupil transportation system.

Grade-crossing Improvement

The intermix of rail and highway traffic at grade crossings has produced a long history of tragic collisions which have resulted in the loss of thousands of lives, three times as many injuries, and millions of dollars in property damage. Interwoven with this history is a record of minimal funding by all levels of government and industry specifically for safety improvements at grade crossings on both the Federal-aid and non-Federal-aid highway systems. As a result, the hazards presented by crossings at grade remain a significant and integral part of the transportation system problem.

The New York Department of Transportation (NYDOT) reports that there are a total of 4,300 highway/railroad crossings at grade in that state, 1,170 on Federal-aid highways and 3,130 on non-Federal roads. About 63 percent of those on non-Federal roads are not specially protected as compared with approximately 30 percent on Federal roads. (Nationwide, about 56 percent of highway/railroad crossings on Federal-aid and approximately 85 percent on non-Federal-aid highways are not specially protected.)

Thirty new installations of grade-crossing protection were completed by NYDOT in 1971. A total of $106,000 was spent on Federal-aid roads and $378,000 on non-Federal-aid roads. Federal expenditures, nationwide, in Fiscal Year 1971, for crossing eliminations (246 projects), reconstruction (40 projects), and installations of active protection (178 projects) totaled $130 million.

The reorganization, under the Federal Railroad Bankruptcy Act, of a large railroad operating within New York complicates the division of the cost of financing grade-crossing-safety improvement projects. This problem is being similarly experienced by other States.

A new policy announced on November 13, 1972, by the Secretary, U.S. Department of Transportation, offers a solution to this problem. A greater share of Federal funds will be available to the States for railroad/highway grade-crossing improvement projects by increasing the Federal and decreasing the railroads' share of the cost of such projects.

Substantial improvements can be accomplished in railroad/highway grade-crossing safety through the selective use of funds specifically allocated for that purpose. A recent Department of Transportation report to Congress on railroad/highway safety stated "if 15,000 crossings were provided with improved protection, accident costs would be reduced by nearly three times the installation and maintenance cost of the improvements."[12] Such a value should not be overlooked in the determination of priorities for the expenditure of Federal highway funds.

The Safety Board has addressed this problem in two previous railroad/highway accident reports.[13] In both reports, the Board recommend that Federal funds be made available for highway/railroad grade crossing safety improvements on non-Federal aid roads as well as on the Federal-aid highway system; and that Congress and the Department of Transportation consider the minimal use of Federal funds by States for grade crossing safety protection because the States apparently prefer to use the funds for general highway expansion or improvements.

IV. CONCLUSIONS

1. The schoolbus driver and the traincrew had an unobstructed view between vehicles when they were within 500 feet of the crossing
2. The train horn was audible for some time prior to the collision to several passengers in the bus as well as to witnesses who were near the crossing. It is not known whether the schoolbus driver heard the train horn.
3. The dark color of the locomotive increased the likelihood of the locomotive's blending into the surrounding environment. This factor, however, was not significant when the schoolbus was still within a safe stopping distance from the track.
4. The schoolbus driver did not stop at the stop sign at the grade crossing. Because of the criminal charges placed against the driver as a result of the accident, his explanation of this failure to stop was not made available to the Board.
5. The schoolbus driver would necessarily have been unable to report for work at 9 a.m. with the New York City Fire Department on the days he drove the morning bus route. At the time of the crash, he was already behind his normal schedule, due to a detour. If he had stopped for the train, he would have been further delayed.
6. There is a need for the scrutiny of schoolbus drivers who hold other jobs which require them to be present at times which could adversely influence their driving behavior.
7. The mechanical condition of the schoolbus and train did not contribute to this accident.
8. The geometry and condition of the road, track, and crossing did not contribute to this accident.
9. The train and its crew were in compliance with all applicable rules and regulations.
10. The route for the schoolbus could have been established to eliminate the Gilchrist railroad/highway grade crossing without affecting the economy or the system.
11. There is a need for the State of New York Department of Education to expand its pupil-transportation activities to assist in training, supervision, and management at the local levels.
12. The administration and management of the pupil-transportation system in the Nyack School District were largely informal. With few exceptions, there were no written policies and procedures. Those provided by the State of New York were not always followed completely.
13. This accident might have been prevented if the crossing had been protected by railroad gates and/or flashing lights. The installation of such active protection devices at crossings on non-Federal-aid highways is limited under existing economics in State and local government and in the railroad industry.
14. The normal crossbuck sign was missing, and the advance-warning sign was placed too close to the crossing to serve as an advance warning.

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[12] U.S. Department of Transportation Report to Congress: Railroad/Highway Safety, Part I: A Comprehensive Statement of the Problem, 1971.

[13] See Footnote 2.

15. The driver was familiar with the existing crossing from the direction of travel usually followed in the completion of the schoolbus route. It is not known what, if any, his familiarity with the crossing was from the direction of approach on the day of the accident.
16. The crash forces produced on the bus by the front surface of the train at about 25 m.p.h. were sufficient to produce direct injury only to passengers in the area directly impacted.
17. Some of the fatal injuries to passengers were the result of abnormal dynamics and contacts which occurred when the bus structure disintegrated.
18. At least two of the five fatalities were ejected as a result of a floor separation and the lack of availability and use of an occupant-restraint system in the bus.
19. The controversy over the feasibility of installing active occupant-restraint systems in schoolbuses suggests the need for a demonstration project to obtain data which can be used to resolve the question.
20. The structural disintegration of the bus displayed many examples of failures at joints assembled with relatively few fasteners; such construction is typical of current schoolbus construction practices.
21. Several of the passengers experienced severe crash injuries from sharp metal edges which were exposed by the separation of structural parts of the bus body.
22. The capacity ratings for schoolbuses used to transport high school students do not always accurately reflect the actual seating capacity of the bus.
23. The special status of innocent passengers transported by schoolbus drivers necessitates that driver qualifications be more than those presently required in many instances. Whenever applicable, the qualifications should be at least equal to those for drivers of interstate motor carriers as found in the Motor Carrier Safety Regulations of the Federal Highway Administration (49 CFR 391).
24. The intended effect of the stop sign was not clear, since a requirement to stop at all times had been abrogated by the absence of any history of local enforcement.

V. CAUSE

The National Transportation Safety Board determines that the cause of this accident was the failure of the schoolbus driver to stop at the stop sign until the crossing was clear of railroad traffic. The reason for this failure could not be determined.

Contributing to the accident was the unnecessary routing of the schoolbus over a not specially protected railroad/highway grade crossing. Contributing to the number of fatalities and the severity of injuries were: (1) the lack of structural integrity of the body of the schoolbus, (2) the absence of highback padded seats and an occupant-restraint system in the schoolbus, (3) the presence of standing students in the bus, and (4) the action of the coupler of the lead locomotive, which caused the crash forces to be concentrated on the bus.

VI. RECOMMENDATIONS

On September 22, 1972, the National Transportation Safety Board directed a recommendation relating to this accident to the National Highway Traffic Safety Administration. (See Appendix D.)

The Safety Board further recommends that:

1. The Department of Transportation seek legislation which would extend the use of Federal funds now available for grade-crossing safety and improvement on the Federal Highway System to include those railroad/highway grade crossings on non-Federal aid highways. (Recommendation No. H-73-9)
2. The National Highway Traffic Safety Administration, in its revision of the Federal Highway Safety Program Standards, continue the requirement which states that schoolbus drivers are to "be qualified as a driver under the Motor Carrier Safety Regulations of the Federal Highway Ad-

ministration 49CFR 391, if he or his employer is subject to the regulations" and to extend that provision (except regarding driver's age) to include all drivers of schoolbuses regardless of whether they or their employer is subject to those regulations. (Recommendation No. H-73-10)

3. The National Highway Traffic Safety Administration, in its revision of the Federal Highway Safety Program Standards, include a provision under the title, Pupil Transportation Safety, which would require those persons responsible for the hiring and supervision of schoolbus drivers to conduct preemployment inquiries and continued surveillance to assure that other employment requirements of schoolbus drivers do not adversely influence their schoolbus driving. (Recommendation No. H-73-11)
4. The State of New York and all other States adopt and implement all the provisions of the present Highway Safety Program Standard No. 17, Pupil Transportation Safety, with special emphasis on the provisions relating to the selection and training of personnel (Personnel, Section IV, C.1), the safe routing of schoolbuses, and the elimination of standees in schoolbuses (Vehicle Operation, IV, C.5.). (Recommendation No. H-73-12)
5. The State of New York Department of Education expand its pupil-transportation safety activities in order to provide liaison, management consultation, and supervision at the local level to assure compliance with its policies and procedures. The State's participation on the local level should also include more active assistance in training pupil-transportation personnel. (Recommendation No. H-73-13)
6. The National Highway Traffic Safety Administration assess the human factors involved in seatbelt usage in schoolbuses through a demonstration project. The project should include a number of buses equipped with seatbelts and highback, padded seats, which are engaged in pupil transportation. (Findings from this project will be useful for evaluation of the provisions found in the proposed Motor Vehicle Safety Standard (Docket No. 73-3), Bus Passenger Seating and Crash Protection). (Recommendation No. H-73-14)
7. The International Association of Chiefs of Police use its influence and resources to redirect the attention of law enforcement agencies to the need for uniform enforcement of traffic laws pertaining to railroad/highway grade crossings (1963 IACP Resolution F-18, Highway Safety Policies for Police Executives). Such enforcement should provide special emphasis on those crossings protected solely with stop signs. (Recommendation No. H-73-15)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

/s/ WILLIAM R. HALEY
Member

March 21, 1973

APPENDIX A
VISIBILITY AT THE CROSSING

Data regarding visibility at the Gilchrist Road grade crossing were gathered under conditions similar to those present at the time of the collision. The observations began sometime after 8:00 a.m., and were conducted with the train crew involved in the accident. A lead locomotive and schoolbus similar to those which collided were used in the demonstration.

The points recorded below are various locations on the pathway of each vehicle as reported by the engineer and a bus passenger when their respective vehicles were visible to each other:

When The Train Was (South of Crossing) Point	The Bus Was (West of Crossing) Point
A - 500 feet	A′ - 600 feet
B - 500 feet	B′ - 480 feet
C - 200 feet	C′ - 125 feet
D - 100 feet	D′ - 45 feet
E - 50 feet	E′ - 0 feet

The points A-A′ were based on a bus passenger's estimate of the location of the bus and locomotive when she first heard the horn and sighted the locomotive. Points B-B′ indicate the engineer's estimate of the positions of each vehicle when he first sighted the bus. Points C-C′ are the estimated positions of the bus and locomotive made by the engineer when he became concerned as to whether the bus would stop prior to the track. Points D-D′ indicate the engineer's estimate of the positions of each vehicle when he put the train brakes into emergency application. Points E-E′ indicate the probable position of each vehicle just prior to impact.

Each of these points was checked during the demonstration, i.e., at each point each vehicle was visible to occupants in the other vehicle.

APPENDIX B
SCHOOLBUS AND TRAIN DATA

Specifications of the Schoolbus

The schoolbus was a 66-passenger 1967 Carpenter body mounted on a 1968 GMC chassis. It was equipped as follows:

Engine:	305 CID V-6 gasoline engine, producing 157 net HP @ 4000 RPM
Transmission:	Single manual 5-speed main box (ratios were: 1st - 7.41, 2d - 4.05, 3d - 2.40, 4th - 1:48, 5th - 1:00)
Rear Axle:	7.20
Brakes:	Air (7¼-cu.-ft. compressor with 2150-cu.-in. air tanks). Total brake area of 190 sq. in. on the front and 314 sq. in. on the rear. The rear brake linings had been replaced February 10, 1972. Records indicated that at the time of the accident 1,645 miles had been accumulated on the rear linings and 18,262 miles on the front linings since their last replacement.
Tires:	9:00/20 Goodrich Mileage 10-ply nylon tires.
Body Structure:	Bow and post construction. A one-piece longitudinal roof rod extends the length of the body. The roof bows are welded to the roof rail. The roof rail is also welded to a full-length post rail to which each body side rail is welded. There is a 7.5-inch-wide internal impact rail inside the exterior side panels. The impact rail is located at the belt line and is welded to each side post. Base rails are welded to the floor sections and to the side posts. The floor sections are integral assemblies, each consisting of a platform plate and a main crossmember. The sections are 26 inches wide. The body had 22 passenger seats, each measuring 39 inches in width and mounted on 27.5 inch centers. The aisle width was 12.5 inches.

Summary of Precrash Mechanical Inspection of the Schoolbus

Schoolbuses in New York State are required to pass mechanical inspections as specified under the Department of Transportation Law of the State of New York. The schoolbus was last inspected on February 16, 1972, at which time three defects were found (loose seat cushions, low-air-pressure buzzer and oil lines to the compressor worn, oil return line chafed). These defects were corrected, and the bus was certified as operational on that date. One phase of the inspection included testing of the foot and hand brakes. The schoolbus was able to decelerate at the required rate of 22 feet/sec.^{2} from an initial speed of 20 m.p.h. The New York State Inspector later stated that he felt the schoolbus was in good condition at the time of the inspection.

Summary of Postcrash Mechanical Inspection of the Schoolbus

Although the air line to the rear brakes was damaged in rescue and retrieval operations, it was possible to pressurize the front and rear brake systems separately. The rear brake systems were pressurized to 160 pounds (normal brake application pressure is 60 to 110 pounds), and the front brake systems to 120 pounds. In all instances the stroke on the brake actuators was found to be normal. The pressure gauge on the instrument panel was operational. After cycling the front brakes three or four times, the gauge maintained a steady pressure for a considerable length of time, indicating there were no leaks in the forward section of the braking system. The low-air-pressure warning flag (wig wag) over the driver's front window was found to be operational.

The wheels and brake drums were removed from the bus to examine the depth of the brake linings. Remaining brake lining depths at the bolt heads were 12/32 inches for both front linings, 16/32 inches for the right rear, and 17/32 inches for the left rear. The brake drums showed very minimal grooving, and there were no indications of deterioration from overheating (heat scoring).

An examination of all tires on the bus was made to assess remaining tread depth. Tread depth on the left front tire was 14/32 inches and on the right front 13/32 inches. The rear tires had been regrooved (4 grooves per tire). The center grooves on the rear tires measured as follows:

Left rear outside	- 4/32 inches
Left rear inside	- 3/32 to 4/32 inches
Right rear outside	- 4/32 inches
Right rear inside	- 3/32 to 4/32 inches

The outside grooves on these tires varied from 8/32 to 12/32 inches. The regrooving process is approved in New York State for schoolbus operation. All tires met State requirements.

The steering system was found to be intact and operational. No excessive linkage play was observed, and it was concluded that no preimpact steering defects existed.

Specifications of the Lead Locomotive

The lead locomotive was builders' model U-25-B, constructed by the General Electric Co., at Erie, Pa., in December, 1965. It is a general-purpose hood-type locomotive with the short hood designating the front. It is 60 feet 2 inches in length (coupler to coupler), 10 feet in width, and has a total weight of 270,090 pounds. It is painted "Brunswick Green," which appears to be almost black. Stenciling is white. The superstructure is mounted on two four-wheel, two-axle, swing-motion swivel trucks. A 16-cylinder, four-cycle, V-type diesel engine rated at 2,500 hp. drives a d.c. generator which powers four d.c. traction motors. One traction motor drives each axle and is supported by the axle and by nose suspensions on the truck. The electrical system is a 72-volt, single-end, d.c. system which operates through a series of switches and magnetic and electro-pneumatic relays actuated through operation of the throttle, reverser, and master controller.

The unit is equipped with Westinghouse Air Brake Company schedule 26-L brake equipment. The brakes can be operated independently or in conjunction with the train brakes. Tests of the braking system performed by the train crew prior to the accident revealed no indication of any braking malfunctions. A postcrash inspection also indicated that the system was operating properly.

The center front windows on the unit are 17 by 27 inches with a centerpost 4 inches wide. Both windows are equipped with air-operated wipers. There is a window 23.5 by 16.5 inches in front of the engineer and a window 23.5 by 12 inches in the front cab door in front of the fireman. Both these windows are equipped with air-operated wipers.

The second locomotive is identical to the first unit in construction and operation. The third unit was builder's model U-33-B, which is powered by a diesel engine rated at 3300 hp. The third unit is otherwise similar in operation and construction to the other two units.

All units are equipped with dual sealed-beam headlights mounted on the top front end of the cab superstructure and the top back end of the engine compartment hood. The headlights are fitted with 200-watt lamps and are controlled by a switch located in the compartment at the engineer's station. A postcrash inspection of the lead unit indicated that the lights were operative.

The lead unit is equipped with a Leslie S3LR air horn rated at 116.5 db. at 140 p.s.i. and at 114.0 db. at 100 p.s.i. at a distance of 100 feet. It is also equipped with a 3-bell chime, the frequencies of which are 255 Hz., 311 Hz., and 440 Hz. A postcrash check of the horn and bells revealed no indication of malfunction.

A complete review of the maintenance records file at the Selkirk, N.Y., Diesel Shop revealed no defects which were pertinent to this accident.

Summary of Postcrash Brake Inspection of the Lead Locomotive

Following its release from the accident site, the train proceeded to Stony Point, N. Y. for inspection. Several component inspections were conducted. The air-brake inspection and tests are of primary interest. These revealed that at the time of examination the brake equipment functioned within design limitations. The pertinent results are duplicated below:

Starting pressure (pounds)	
Main reservoir	
Governor cut-in	130
Governor cut-out	140
Brake pipe	90
Equalizing reservoir	90
Application pressure (pounds)	140
Independent Brake cylinder pressure (pounds)	45

Independent Brake Value Test:		
Application	0 to 45 pounds	5 seconds
Release	45 to 0 pounds	4 seconds

Automatic Brake Value Test:		
Service Reduction	90 to 65 pounds	
Application	0 to 60 pounds	9 seconds
Release	60 to 0 pounds	8 seconds
Emergency Application	0 to 75 pounds	11 seconds
Brake cylinder pistons applied in		1.2 seconds
Emergency sanding		1.5 seconds
Emergency release	76 to 0 pounds	13 seconds

Safety Control (Deadman) Test:

Application	0 to 62 pounds	30 seconds

6-second delay after pedal released to start of split reduction

10 seconds total elapsed time for 8-pound reduction. W/22 pounds brake-cylinder pressure

30 seconds total elapsed time to full 62-pound brake-cylinder pressure

Fireman's Emergency Brake Value Test:

Application	0 to 72 pounds	11 seconds
Release	72 to 0 pounds	13 seconds

Brake Pipe Leakage Test:

Leakage of 1 1/2 to 2 pounds per minute

Brake Cylinder Piston Travel

Lead locomotive:

R1	3 1/2"	L1	2 3/4"
R2	2 3/4"	L2	1 3/4"
R3	2 3/4"	L3	2 7/8"
R4	2 5/8"	L4	2"

2d locomotive:

R1	3 3/4"	L1	2 7/8"
R2	4 3/4"	L2	3 7/8"
R3	4 1/2"	L3	4 1/2"
R4	5 3/4"	L4	4 1/2"

3d locomotive:

R1	3 1/4"	L1	4 1/2"
R2	3 1/2"	L2	4 3/8"
R3	4 1/4"	L3	4 1/4"
R4	4 1/4"	L4	3 3/4"

Driver: Age 35, Male.
Injuries: Fracture of left clavicle - with displacement.

Row 1, Left Outboard Seat: Age 16, Male.
Injuries: Contusion of the spine; concussion; multiple contusions and abrasions.

Row 1, Left Inboard Seat: Age 15, Male.
Injuries: Laceration to the forehead, and contusion to the elbow.

Row 1, Right Inboard Seat: Age 14, Male.
Injuries: Cerebral concussion; laceration to the forehead; and fractured nose.

Row 1, Right Outboard Seat: Age 14, Male.
Injuries: Cerebral concussion; multiple abrasions; and hematoma right periorbital area.

Row 2, Left Outboard Seat: Age 16, Male.
Injuries: Laceration to cheek and the back; fractured ribs, 9-10th (right retroperitoneal hematoma); traumatic shock.

Row 2, Left Inboard Seat: Age 16, Male.
Injuries: Cerebral concussion; Multiple contusions and abrasions; severe abrasion to the left knee.

Row 2, Right Inboard Seat: Age 18, Female.
Injuries: Fracture compound, nasal bones with displacement; fracture humerus; multiple contusions and abrasions; fractured ramus of pubic bone, right and left.

Row 2, Right Outboard Seat: Age 17, Female.
Injuries: Fractured pelvis; lacerations to the bladder, cheek, and buccalcavity; fractured skull; perforation left ear drum; and hypovolemic shock.

Row 3, Left Outboard Seat: Age 14, Male.
Injuries: Multiple contusions and abrasions.

Row 3, Left Inboard Seat: Age 16, Male.
Injuries: Fractured left femur; fractured right tibia fibula.

Row 3, Right Inboard Seat: Age 14, Female.
Injuries: Cerebral concussion; fractured ribs left 9-11th; fractured right pubic rami; lacerated scalp; multiple contusions and abrasions; urinary tract infection; strain of cervical spine.

Row 3, Right Outboard Seat: Age 15, Female.
Injuries: Cerebral concussion; severe contusions to chest wall; elbows abdomen, and bladder.

Row 4, Left Outboard Seat: Age 15, Male.
Injuries: Cerebral concussion; laceration to scalp - occipital.

Row 4, Left Inboard Seat: Age 16, Male.
Injuries: Contusion to left foot.

Row 4, Aisle: Age 14, Male.
Injuries: FATAL - Fracture and dislocation of C 4 vertebra; complete transection of the axillary artery and vein; transection of the entire axilla with dislocation of the humerous, from the shoulder girdle; bloody cerebrospinal fluid, intracisternal puncture.

Row 4, Right Inboard Seat: Age 16, Female.
Injuries: Cerebral concussion; lacerations to cheek and oral; fractured ribs, right side; fracture both pubic rami; paralytic ileus; traumatic shock.

Row 4, Right Outboard Seat: Age 17, Female.
Injuries: Traumatic amputation of right leg, below knee; fractured left clavicle; contusion to left eye; fractured ribs, 10-11th fractured left tibia and fibula.

Row 5, Left Outboard Seat: Age 15, Male.
Injuries: Cerebral concussion; fractured left clavical; separation left acromip - clavicot; fractured left ribs.

Row 5, Left Inboard Seat: Age 16, Male.
Injuries: FATAL - severe mutilation of the skull and upper spinal cord; fractures of right forearm, right and left femurs, right and left tibias, right and left fibulas, ribs right 2-8; transection of left arm; lacerations of body and all extremities; lung contusions, bilateral.

Row 5, Aisle: Age 14, Male.
Injuries: FATAL - Intracerebral hemorrhage; comminuted fractures proximal tibia - fibula, left; severe lacerations to right and left legs; compound fracture mandible - hemorrhage.

Row 5, Right Inboard Seat: Age 14, Male.
Injuries: Cerebral concussion; fractured ramus of pubis pelvis; right pnuemothorax; sprain cervical spine; multiple lacerations with palsy 6th nerve, left side, complete.

Row 5, Right Outboard Seat: Age 16, Female.
Injuries: Cerebral trauma; cerebral concussion; partial amputation below knee, fractured compound - comminted leg (later amputated).

Row 6, Left Outboard Seat: Age 17, Male.
Injuries: Lacerated scalp contusion - sprain dovso - lumbar spine.

Row 6, Left Inboard Seat: Age 16, Male.
Injuries: Fractured ribs, right 8-9th and left 1st; fractured skull; fractured left tibia at the knee.

Row 6, Aisle: Age 14, Male.
Injuries: Fractured femur; fractured tibia and fibula, both right and left legs.

Row 6, Right Inboard Seat: Age 18, Male.
Injuries: FATAL - Severe mutilation of the brain, skull and upper spinal cord, fracture of the right mandible; lacerations to the right and left tempero-parietal frontal arca, right ear; and abrasions of the gluteal area.

Row 6, Right Outboard Seat: Age 16, Male.
Injuries: FATAL - Right subdural hematoma; right pneumothorax Atelectasis and pneumonia right lobe.

Row 7, Left Outboard Seat: Age 17, Female.
Injuries: Cerebral concussion; severe lacerations to left knee and right forehead.

Row 7, Left Inboard Seat: Age 16, Female.
Injuries: Cerebral concussion; severe lacerations to scalp (foreign bodies of scalp and right knee), fractured closed right ankle.

Row 7, Aisle: Age 14, Male.
Injuries: Cerebral concussion; lacerated scalp and forehead; severe contusions.

Row 7, Right Inboard Seat: Age 14, Male.
Injuries: Fracture compound, left tibia; lacerations left leg; lacerations facial, lips, and eyelid.

Row 7, Right Outboard Seat: Age 14, Male.
Injuries: Cerebral injury; cerebral concussion; partial amputation right leg; compound fracture tibial/fibula, right leg; lacerated scalp; fractured clavicle.

Row 8, Left Outboard Seat: Age 18, Female.
Injuries: Cerebral concussion; contusions and abrasions.

Row 8, Left Inboard Seat: Age 16, Female.
Injuries: Cerebral concussion; fractured tibia/fibula; lacerated scalp.

Row 8, Aisle: Age 18, Male.
Injuries: Lacerated scalp; abrasions to face and right leg.

Row 8, Right Inboard Seat: Age 15, Male.
Injuries: Cerebral concussion; multiple contusions and abrasions; hematoma right eye.

Row 8, Right Outboard Seat: Age 16, Male.
Injuries: Fractured maxilla; facial lacerations; loss of teeth.

Row 9, Left Outboard Seat: Age 15, Female.
Injuries: Fractured closed shaft right femur; contusion of sternum.

Row 9, Left Inboard Seat: Age 15, Male.
Injuries: Cerebral concussion; lacerations to lip and face; severe contusions of face and jaw; possible fracture zyoma; cervical sprain.

Row 9, Aisle: Age 16, Female.
Injuries: Cerebral concussion; multiple abrasions; minor lacerations to legs.

Row 9, Right Inboard Seat: Age 17, Female.
Injuries: Cerebral concussion; lacerated forehead; fractured nasal bones.

Row 9, Right Outboard Seat: Age 14, Male.
Injuries: Multiple contusions and abrasions.

Row 10, Left Outboard Seat: Age 16, Female.
Injuries: Cerebral concussion; multiple contusions and abrasions; severe contusion left ankle.

Row 10, Left Inboard Seat: Age 16, Female.
Injuries: Cerebral concussion; lacerated scalp - occupital.

Row 10, Aisle: Age 16, Male.
Injuries: Lacerations of face, chin, scalp; compression fracture 7-8-10th thoracic vertebrae.

Row 10, Right Inboard Seat: Age 16, Male.
Injuries: Fracture compound displaced, left maxilla - zygoma fracture floor or bital bone; abscess left temporal area; cerebral concussion; lacerations to face and scalp; fractured right radius - wrist.

Row 10, Right Outboard Seat: Age 15, Male.
Injuries: Acute cervical strain; fracture, fourth metacarpal, left wrist.

Row 11, Left Outboard Seat: Age 17, Female.
Injuries: Multiple contusions and abrasions.

Row 11, Right Outboard Seat: Age 16, Male.
Injuries: Cerebral concussion; contusion of the chest wall; multiple contusions and abrasions.

lyzed the problem of extensive failures of structural joints in schoolbuses in a special study, "Inadequate Structural Assembly of Schoolbus Bodies," issued July 29, 1970. The Board also recommended on September 18, 1968, that the National Highway Safety Bureau, predecessor to NHTSA, ". . . consider the need for requirements for structural strength of schoolbus bodies in connection with its study of desirable standards for protection of schoolbus occupants. In particular, the Board recommends that program A.1.1.4 of the National Highway Safety Bureau titled 'Design, Fabrication, and Test of a Safe Schoolbus Interior,' be expanded in scope to include consideration of structrual integrity and intrusion into the schoolbus interior."

As stated above, there are indications in the Congers accident that the failures of structural joints contributed to the injuries of the occupants. The speed of the schoolbus was slow and the speed of the train was moderate, apparently not more than 30 miles per hour. Although about two-thirds of the bus structure was accelerated to the full speed of the train by the impact, a majority of the schoolbus occupants survived and some received only relatively minor injuries. However, the penetration of the gross structure of motor vehicles in crashes, or the disintegration of the structure, generally does tend to reduce the probability of survival and increase the probability of injury.

In this connection, structural improvements which have been made by other agencies and private manufacturers in response to the Safety Board's earlier recommendations are important. In January 1971, the Vehicle Equipment Safety Commission (VESC) adopted a regulation which, when implemented by the States, would require that all schoolbuses under State purchasing authority have substantially increased strength of structural joints. The exact wording of this part of the regulation is attached as Appendix A. At least two schoolbus manufacturers have built and exhibited prototype buses which apparently meet this requirement. These prototypes are constructed of much larger steel sheets to reduce the number of joints, in effect providing 100-percent joint efficiency wherever a joint was eliminated. In addition, many more rivets are used to join sheets and structural members. An analysis by one manufacturer indicated that approximately half the joints have been eliminated and that about six times as many rivets are used in meeting the VESC specification than were used in the earlier designs which had unspecified joint strength. It appears that changes in the VESC specification increases the strength of the joints in a schoolbus body approximately fivefold.

The technical feasibility of implementing the VESC structural specification appears to be well established by these prototype buses. One of the manufacturers has stated that the change in sale price of a bus having more complete assembly of structural joints was only approximately 5 percent of the total cost.

The Safety Board is aware that the VESC specification does not insure the structural strength of schoolbus bodies. It is, no doubt, preferable to control the structural strength of bus bodies and chassis as a unit through the development and application of large-scale crash tests. However, the development of such tests and their use as standards have been very slow, as even passenger cars are not yet subjected to such testing. This critical weakness of schoolbus bodies must be eliminated as quickly as possible. Additionally, the VESC specification, in part, meets the statutory requirement of DOT that safety characteristics be controlled by performance rather than design.

It is the Board's opinion that the very high value that society places upon the protection of children riding in schoolbuses establishes the need for improvement in structural design. The adoption of a standard to control the assembly of structural joints in schoolbuses should not be regarded as a novel initiative to reduce schoolbus fatalities, but as correction of a long standing failure to employ normal engineering practices in schoolbus construction. Many existing schoolbuses do not meet rivet-spacing recommendations of SAE Standard J-492, Rivets and Riveting, June, 1961.

While NHTSA is taking steps to correct the structural inadequacies of schoolbus bodies through the establishment of standards to control strength of joints, they should resolve the problem of the column strength of schoolbuses. The failure of the window columns is very evident in the accident at Congers, New York. Because of the similarity in construction methods used for domestically produced schoolbuses, the overall strength of schoolbus bodies possibly could be controlled through performance requirements of individual structural elements prior to the development of the full-scale tests which are more technically complete.

For the above reasons, the National Transportation Safety Board recommends that:

> The National Highway Traffic Safety Administration expeditiously adopt a Federal Motor Vehicle Safety Standard to control the strength of structural joints of schoolbuses. In this connection careful consideration should be given to requirement 5.6 Body Structure, of the Vehicle Equipment Safety Commission. This standard should also apply to the strengthening of the window columns of schoolbuses.

This recommendation will be released to the public on the issue date shown above. No public dissemination of the contents of the document should be made prior to that date.

Reed, Chairman; McAdams, Burgess, and Haley, Members, concurred in the above recommendation. Thayer, Member, was absent, not voting.

By: John H. Reed
Chairman

Enclosure

APPENDIX A

Vehicle Equipment Safety Commission
Regulations VESC-6
Minimum Requirements for Schoolbus
Construction and Equipment
Approved January 1971
Revised February 1972
Washington, D. C.

5. BODY STRUCTURE:

5.6 Strength of structural joints of Schoolbus bodies. It is the intent of this section to insure that all structural joints within bus bodies which employ discrete fasteners, including those between heavy gauge members and those which join panels to panels or panels to heavier structures, achieve a significant proportion of the strength of the parent metal, so that all available panel materials are capable of serving as part of the structure. Accordingly, in all joints of the above named types which employ discrete fasteners such as rivets, screws or bolts, the pitch of fasteners shall not exceed 24 times the thickness of the thickest material used in the joint. Alternatively, for any method of joining such structural members, it shall be demonstrated by calculation that the strength of such joints is at least 60% of the tensile strength of the thinest joined member.*

* (Board Comment: This sentence states the requirement in terms of performance.)