

PB84-916201



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

HIGHWAY ACCIDENT REPORT

VALLEY SUPPLY COMPANY
TRUCK TOWING FARM PLOW/
ANCHOR MOTOR FREIGHT INC.
CAR-CARRIER TRUCK/NEW YORK—
STATE ASSOCIATION FOR RETARDED CHILDREN BUS
COLLISION AND FIRE, STATE ROUTE 8,
NEAR HOLMESVILLE, NEW YORK
APRIL 5, 1983

NTSB/HAR-84/01

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16. Abstract <p>On April 5, 1983, a 2-ton flatbed truck, loaded with one farm plow and towing another farm plow, was traveling southbound on a two-lane, two-way rural highway near Holmesville, New York. An adult passenger bus, with 20 persons on board, was following the flatbed truck at a distance of about 100 feet. As both vehicles entered a 3,820-foot-radius right curve, the towed plow suddenly separated from its hitch attachments and veered left into the opposing northbound traffic lane. A northbound tractor car-carrier semitrailer struck the plow, rupturing the tractor's left front tire. As a result, the driver lost control of the vehicle, and the vehicle veered left across the highway centerline and collided head-on with the bus. The bus driver and four bus passengers were killed. The truck driver of the car carrier and nine bus passengers were hospitalized with various degrees of injury. Six bus passengers were treated and released.</p> <p>The National Transportation Safety Board determines that the probable cause of this accident was the towing of a farm plow on a highway at a speed which did not permit the farm plow to track properly behind the flatbed truck and the use of an unapproved tow hitch device. Contributing to the cause was the failure to use safety chains to preclude vehicle separation in the event of a tow hitch failure. Contributing to the severity of injuries of some of the bus passengers was the lack of effective occupant protection from secondary impacts with interior surfaces.</p>					
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WASHINGTON, D.C. 20594**

HIGHWAY ACCIDENT REPORT

Adopted: April 3, 1984

**VALLEY SUPPLY COMPANY TRUCK TOWING FARM PLOW
ANCHOR MOTOR FREIGHT INC. CAR-CARRIER TRUCK
NEW YORK STATE ASSOCIATION FOR RETARDED CHILDREN BUS
COLLISIONS AND FIRE
STATE ROUTE 8, NEAR HOLMESVILLE, NEW YORK
APRIL 5, 1983**

SYNOPSIS

On April 5, 1983, a 2-ton flatbed truck, loaded with a farm plow and towing another farm plow, was traveling southbound on a two-lane, two-way rural highway near Holmesville, New York. An adult passenger bus, with 20 persons on board, was following the flatbed truck at a distance of about 100 feet. As both vehicles entered a 3,820-foot-radius right curve, the towed plow suddenly separated from its hitch attachments and veered left into the opposing northbound traffic lane. A northbound tractor car-carrier semitrailer struck the plow, rupturing the tractor's left front tire. As a result, the driver lost control of the vehicle, and the vehicle veered left across the highway centerline and collided head-on with the bus. The busdriver and four bus passengers were killed. The truck driver of the car carrier and nine bus passengers were hospitalized with various degrees of injury. Six bus passengers were treated and released.

The National Transportation Safety Board determines that the probable cause of this accident was the towing of a farm plow on a highway at a speed which did not permit the farm plow to track properly behind the flatbed truck and the use of an unapproved tow hitch device. Contributing to the cause was the failure to use safety chains to preclude vehicle separation in the event of a tow hitch failure. Contributing to the severity of injuries of some of the bus passengers was the lack of effective occupant protection from secondary impacts with interior surfaces.

INVESTIGATION

The Accident

About 3:40 p.m., eastern standard time, 1/ on April 5, 1983, a 2-ton flatbed truck, loaded with a farm plow and towing another farm plow, was traveling southbound on State Route 8, a two-lane, two-way highway, about 1.5 miles south of Holmesville, Chenango County, New York. The plow in tow was semi-mounted on a dolly which was connected to a steel towbar on the rear of the truck. The weather was clear and dry. A type V 40-adult passenger bus 2/ with the driver and 19 adult passengers aboard was following

1/ All times herein are eastern standard time.

2/ A type V 40-adult passenger bus is defined in the New York State purchase specifications, group 40520-Buses (Department of Transportation), as a bus with 77-inch aisle headroom adopted from a conventional style 25,000 G.V.W.R. schoolbus. (See appendix B.)

the flatbed truck at a distance of about 100 feet. As the flatbed truck and bus entered a 3,820-foot-radius right curve, the towed plow suddenly separated from its dolly hitch attachments and traveled into the opposing northbound traffic lane. A northbound tractor car-carrier semitrailer (combination vehicle), 3/ which was not carrying cars at the time, struck the plow. The truckdriver stated that the piece of farm equipment came into his path of travel so quickly that he had no time to avoid it. Following the impact with the plow, the truckdriver lost steering control. The combination vehicle veered left across the highway centerline and struck the bus. Initial impact occurred between the left front of the bus and the left front of the combination vehicle. (See figure 1.)

As a result of the impact, the front axis of the bus was separated from the bus body, and the bus was driven rearward about 50 feet before coming to rest against a box beam guardrail, which bordered the roadway shoulder, and a tree, which was 15 feet behind the guardrail. As a result of the impact with the bus, the combination vehicle jackknifed and subsequently came to rest with the front of the tractor north of the final rest position of the bus. (See figure 2.) A fire erupted in the tractor which destroyed the cab and engine compartment. The fire was confined to the tractor.

Witness Observations

A northbound motorist stated that the combination vehicle had been following him for several miles. According to this motorist, both he and the driver of the combination vehicle were traveling at a speed of about 50 mph as they approached the accident site. The motorist stated that he "happened to glance" into his rearview mirror and saw the combination vehicle "...suddenly begin to move toward the oncoming bus." According to this motorist, the combination vehicle had been operating in a safe manner up to that point.

The adult monitor 4/ on the bus stated that the farm plow in tow had been moving laterally in its lane of travel, and that as a result, the busdriver had reduced his speed and had been traveling about 100 feet behind the moving plow.

A southbound motorist stated that she had been following the accident bus at a distance of about three car lengths for approximately 1 mile. She further stated that she had remained behind the bus because the towed equipment (farm plow) in front of the bus was "wobbling back and forth" within its lane of travel. According to this witness, as the northbound combination vehicle approached the accident site, something apparently struck the combination vehicle and caused it to swerve into the southbound lane, "as though it had lost one of its front wheels." The motorist stated that when the combination vehicle struck the bus, she "dammed on her brakes" to avoid the collision. She further stated that the bus and her vehicle had been traveling at a speed between 35 and 40 mph just before the accident.

A resident, who was working in his yard 200-300 yards from the accident site, stated that he heard the noise of the collision and saw black smoke and immediately ran to the accident scene. When he arrived, he saw smoke coming from the tractor of the combination vehicle and he ran to assist the truckdriver pinned inside the cab. He helped the driver out of the cab and pulled him to safety. He then assisted the injured passengers in the bus.

3/ Combination vehicle -- a vehicle with power pulling another vehicle without power.

4/ The adult monitor was employed by the Community Workshop (CWS) to accompany the passengers, all of whom had some degree of developmental/physical handicap or impairment and were CWS clients, to and from the workshop where the clients performed light manufacturing and assembly work. The CWS was located about 10 miles north of the accident site.



Figure 1.--Northbound view of accident scene. (Markings not identified by labels are not relevant to the investigation.)

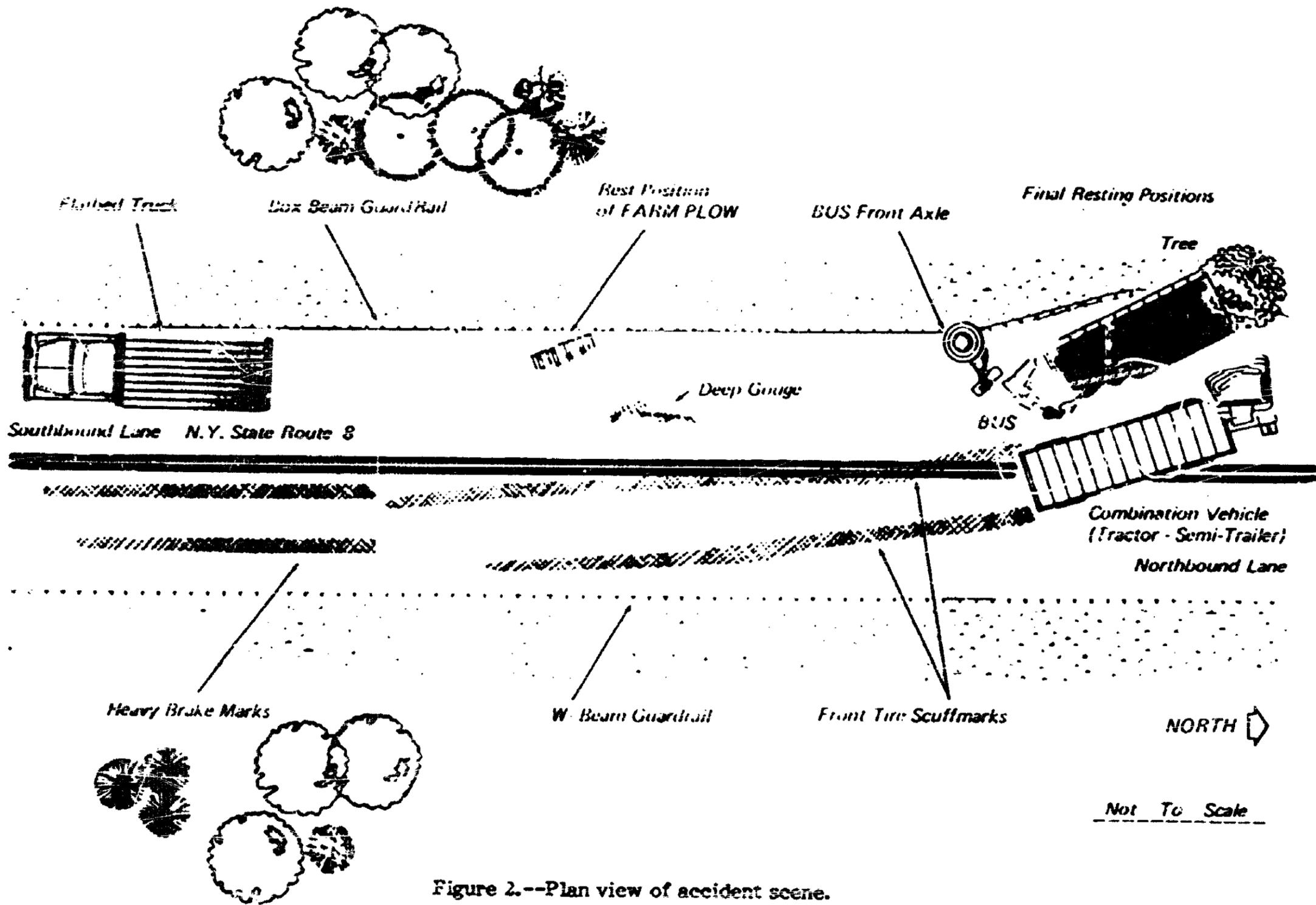


Figure 2.--Plan view of accident scene.

Emergency Response

The accident occurred within the town limits of Norwich, New York; however, by prior arrangement, the South New Berlin (SNB) Volunteer Fire Department and ambulance service was responsible for responding to emergencies at that location.

At 3:41 p.m., a resident who lived near the site of the accident and heard the collision notified the Chenango County Control Center ^{5/} of the accident. The resident reported that a schoolbus and truck had collided and that there was a fire on Route 8. Shortly thereafter, the dispatcher received a second call from the same resident who reported that the bus involved in the accident was a CWS bus. Within 5 minutes of the resident's first telephone call, the SNB fire chief had been notified of the accident and an SNB ambulance, equipment truck, and tanker were en route to the scene. The fire chief was the first emergency response unit to arrive at the accident site, at 3:48 p.m. He immediately requested that the dispatcher notify more ambulances and informed the dispatcher that 15 to 20 persons were injured. Because of mutual aid agreements with nearby jurisdictions, additional ambulances were notified and responded to the emergency. The dispatcher also notified the Chenango Memorial Hospital in Norwich that it would be receiving 15 to 20 injured persons. The hospital immediately began to implement its disaster plan and set up a triage center at the scene. Two other area hospitals were also advised in advance that they would be receiving injured victims. Approximately 100 emergency response personnel responded to the accident. Injured persons were transported to three area hospitals.

A few of the passengers had evacuated the bus with the help of the residents who had first arrived at the scene. While firefighters extinguished the tractor fire and deputy sheriffs (who had been notified of the accident by the Chenango County Control Center dispatchers) controlled the flow of traffic to and from the accident site, other emergency response personnel continued their efforts to extricate the passengers that remained on board the bus. The main boarding door was jammed closed, and as a result a few of the passengers were passed through the opening in two emergency windows on the right side; a few passengers were extricated after a Hurst Tool was used to enlarge an opening on the left side of the bus; and the majority of passengers were evacuated through the wheelchair ramp door exit. Because the rear of the bus was up against a large tree, passengers were unable to evacuate the bus through the rear emergency exit door.

Five of the bus occupants, including the driver, were killed as a result of the collision. The driver of the combination vehicle, the adult monitor on board the bus, and eight bus passengers were hospitalized. Six bus passengers were treated and released.

Injuries to Persons

<u>Vehicle/ Occupants</u>	<u>Fatal</u>	<u>Hospitalized</u>	<u>Treated and Released</u>	<u>None</u>	<u>Total</u>
Flatbed Truck Driver				1	1
Combination Vehicle Driver		1			1
Bus Driver	1				1
Monitor on Bus		1			1
Bus Passengers	4	8	6	0	18
Total	5	10	6	1	22

^{5/} The SNB Fire Department emergency telephone is answered by the Chenango County Control Center dispatcher who then notifies the appropriate response units.

Vehicle Information and Damage

Flatbed Truck, Dolly, and Farm Plow.—The 1979 Chevrolet 2-ton truck, owned and operated by the Valley Supply Company, had a sliding hydraulic flatbed mounted body. At the time of the accident, the truck was carrying one farm plow on the flatbed and towing a John Deere model P145A moldboard plow mounted on a two-wheel converter dolly connected to a steel drawbar mounted on the rear of the flatbed. (See figure 3.) Valley supply company transported farm plows both by flatbed truck and by dollies. The dolly was connected to the drawbar by a quick coupler type attachment. Horizontal pins on the crossbar dropped into hooks (sockets) on the dolly; manually operated spring latches then closed and prevented the pins from pulling out. There were no safety chains connecting the dolly to the draw bar or the plow to the dolly. The dolly and quick coupler device were not approved by the New York Department of Motor Vehicles. The plow in tow was being delivered to a local farm when the accident occurred. The John Deere plow was about 13.75 feet long and weighed approximately 2,300 pounds. (See figure 4.) It was painted green. According to the manufacturer, the plow was designed as a slow-moving vehicle (not to exceed a maximum travel speed of 20 mph).

The flatbed truck and the two-wheel dolly and its hitch attachment were not damaged in the collision sequence. The John Deere farm plow sustained considerable damage. The fourth plow blade was found bent rearward and in its upright position. The cross frame at the front of the plow was bent rearward, the rear steering rod was bent and abraded in the center, and the rocker linkage was broken. The plow frame was bent and gouged on the upper right hand corner.

The rear wheel of the plow was broken away from its hub, and the mounted tire was severely cut and flat. The tire on the rear wheel was a self-cleaning tire with a mud grip tread pattern and lugs. There were no apparent nail holes or punctures in the tire. The fan-shaped tire marks on the pavement surface at the accident site matched the lug spacing for the rear tire mounted on the plow.

A "slow moving vehicle" sign was not mounted on the rear of the plow before the trip according to the Valley Supply Company personnel.

Combination Vehicle.—The 1978 Chevrolet three-axle 6/ tractor pulling a 1976 Whitehead and Kates Car Carrier two-axle semitrailer was owned and operated by the Anchor Motor Freight Inc. The combination vehicle was approximately 55 feet long and 8 feet wide, and the probable weight at the time of the accident was 39,100 pounds. (See figure 5.) It was painted blue and equipped with a diesel engine, air-mechanical service brakes, power steering, and a seatbelt on the driver's seat. Impact and fire damage was primarily confined to the tractor of the combination vehicle.

The left front bumper was bent rearward and downward. The left front tire and wheel assembly was distorted outboard and had been pushed rearward into the left side cylindrical fuel tank. The left front tire was flat and partially burned and had a large gash in the tire carcass. The rim on the tire had metal-to-metal contact marks along the outer surface. The front tractor axle was displaced rearward on the left side and both frame rails were bent leftward. The overhead rack and left vertical supports separated from the tractor and the engine was pushed rearward during impact.

6/ The second axle of the three-axle tractor was an unpowered auxiliary axle that was retracted at the time of the accident.

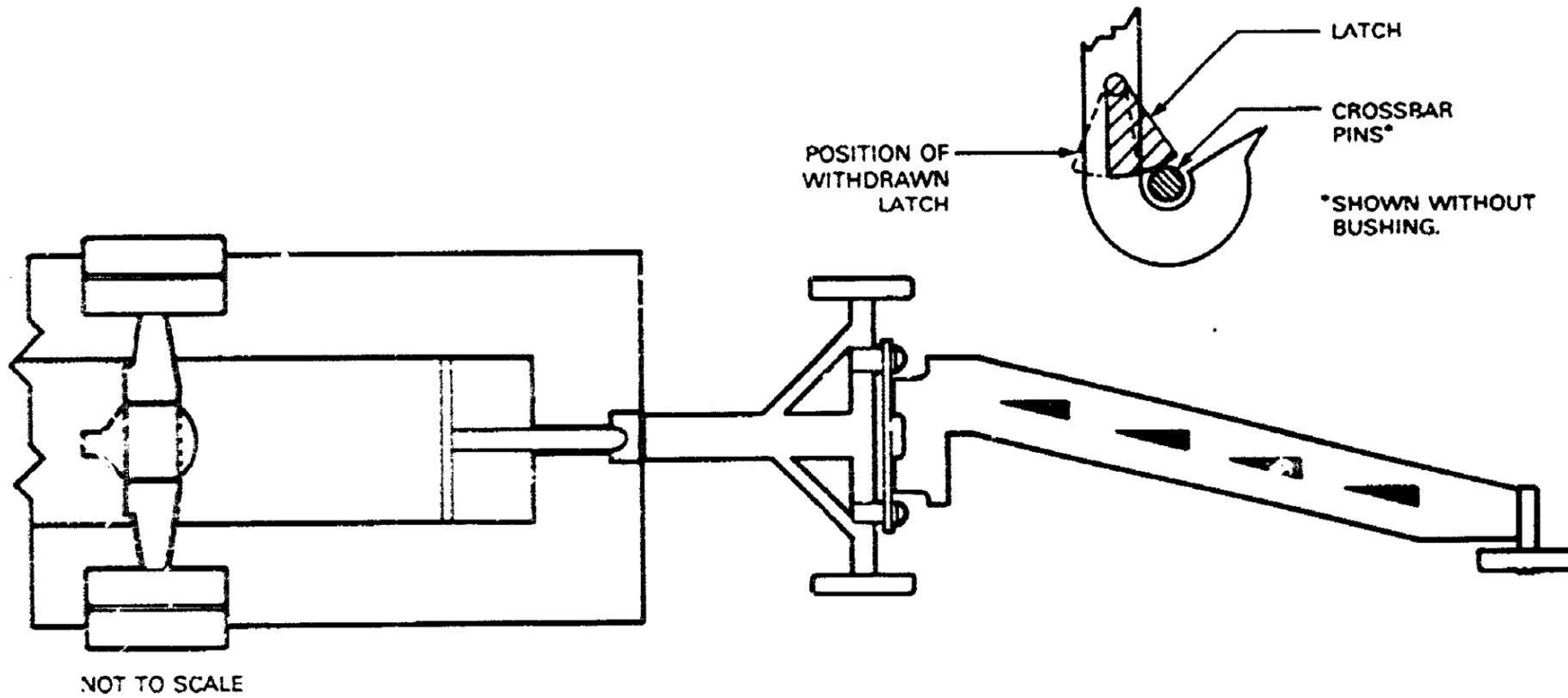
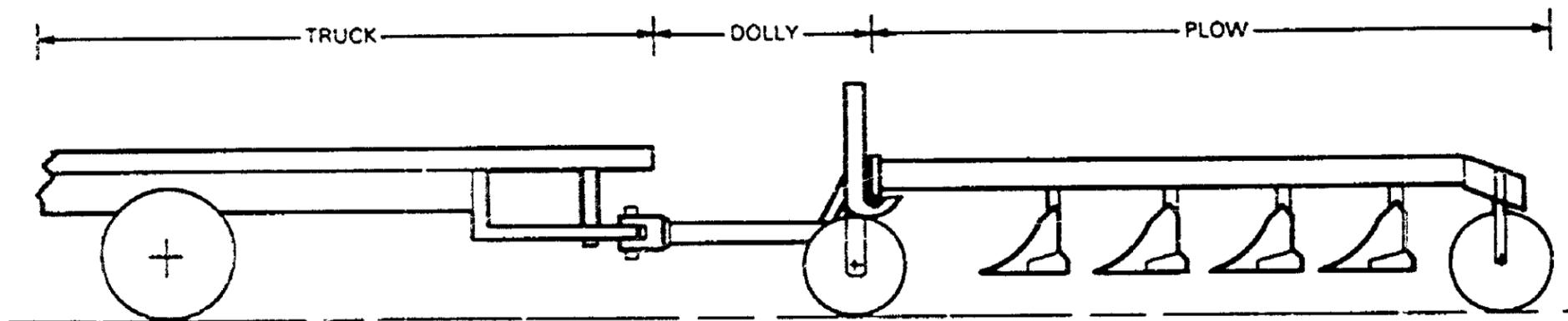
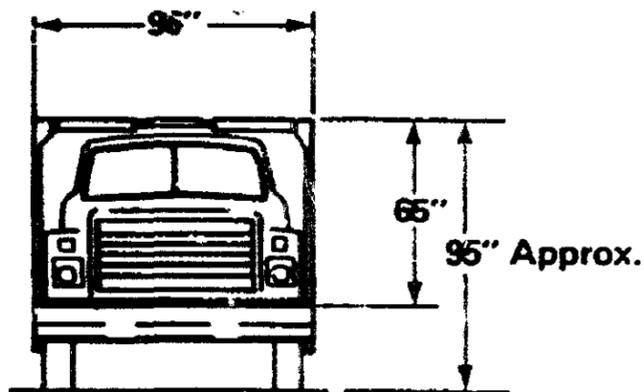


Figure 3.—Schematic arrangement of truck, dolly, and plow.



Figure 4.—Final rest position of John Deere plow.



- 151 Inches—Front Bumper to 5th Wheel Pin
- 139 Inches—Wheel Base
- 96 Inches—Width of Tractor
- 65 Inches—Height from Top of Bumper to Top of Headramp
- 95 Inches—Height from Ground to Top of Headramp (Approx.)
- 55 Feet—Total Length of Tractor-Trailer Hook Up

Sharp Profile
Overhead Ramp

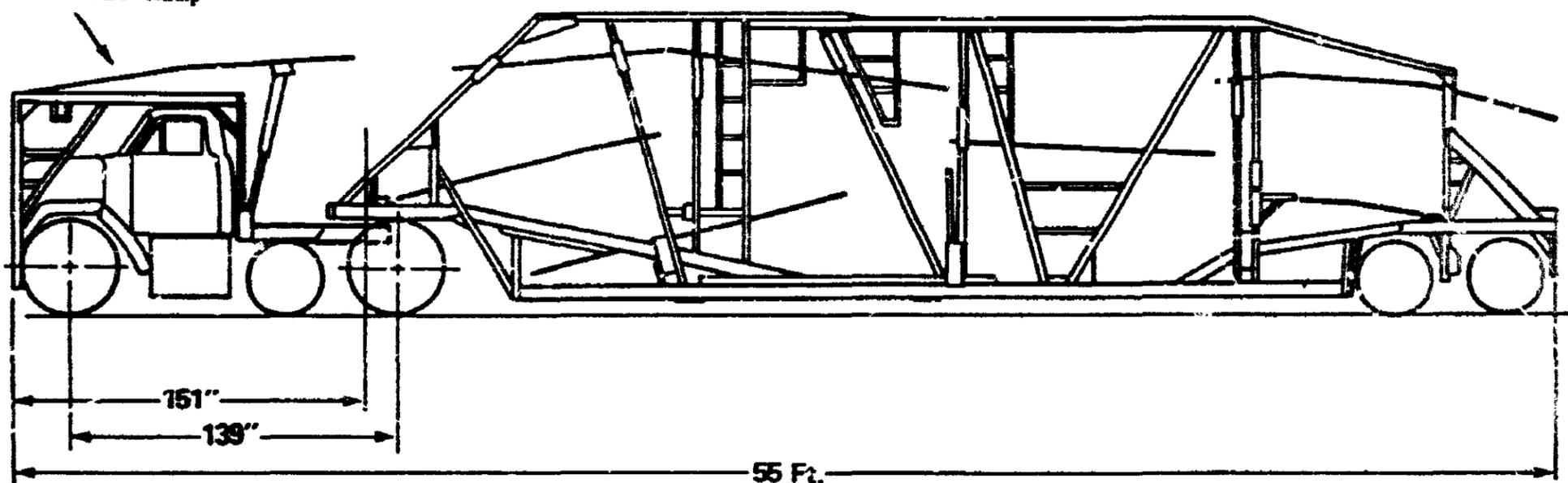


Figure 5.—Diagram of tractor car-carrier semitrailer.

Fire damage had consumed the fiberglass hood and fenders, the front grill and radiator, several non-metallic engine components, and several electrical wiring harnesses. The interior of the driver's compartment was completely gutted by fire. The large rear window was missing and two smaller windows were damaged. The windshield was also missing. The semitrailer sustained relatively minor damage and apparently did not contact the bus during the impact sequence. However, the front of the semitrailer did contact the rear of the tractor cab during the jackknifing sequence. The rear well of the tractor cab was separated and pushed forward along the floor area, and the driver's seat was displaced forward. The fifth wheel, which is normally mounted to the tractor, was torn away during the jackknifing sequence and was found attached to the semitrailer during the postaccident inspection.

The slack adjustments for the service brakes of the combination vehicle were not measured. The front axle service brake chambers on the tractor were damaged by fire; the right rear brake chamber of the tractor was damaged from impact; and the two trailer service brakes had been released for towing when the semitrailer was removed from the scene.

Adult Passenger Bus.—The bus was a 1982 Chevrolet Chassis mounted to a model MS-29, 40-passenger (schoolbus type) American Transportation body. The bus was painted blue and equipped with air-mechanical service brakes, a diesel engine, a 5-speed transmission, and several safety features such as warning buzzers for emergency door and windows, padded stanchions and guardrails, wheelchair restraints, 7/ reinforced body floor sills, and stronger seat anchorages. The bus was owned and operated by the Community Work Shop (CWS), an affiliate of the New York State Association for Retarded Children (NYSARC). The probable loaded weight of the bus at the time of the accident was 20,000 pounds. (See figure 6.)

The 8-foot-wide bus was purchased new in October 1982 and had been in service about 6 months when the accident occurred. The bus was equipped with 8 rows of transit-type seats (2 seats on each side of the aisle). The busdriver's adjustable seat was equipped, and required to be equipped, with a seatbelt. The bus was also equipped with six 9.00-20 tires, all of which were inflated after the accident and had a minimum tread depth of 9/32 inch. The wheelchair positions were equipped with occupant restraints.

Five emergency window exits were located on the left side of the bus and four on the right side. The windows could be unlocked only from the inside of the bus and were hinged at their tops. The exits were placarded inside the bus with instructions for opening in the case of an emergency. According to the bus manufacturer, the windows weighed about 26 pounds. An emergency exit door was located at the rear of the bus, similar to that in a schoolbus. There were no exterior placards/labels to show the rear door as an emergency exit although the manufacturer's engineering drawings showed the door as an emergency exit. The door was marked "Emergency Exit" inside the bus.

There was no placard, and none was required, on the outside of the bus to indicate that the bus routinely carried mentally and physically handicapped passengers.

A wheelchair ramp/lift, which was powered by an electro-hydraulic actuator, was located in the right rear. The lift could be operated with an electrical hand control from inside or outside the bus; the lift could be operated without electrical power by manual operation of the hydraulic system valve which was accessible only from inside the bus. There were provisions in the left rear of the bus to lock two wheelchairs to the floor. The wheelchairs faced inboard toward the wheelchair ramp/lift door. The exterior of the wheelchair ramp/lift door was marked "emergency exit."

7/ Wheelchair restraints include wheelchair locks and lap belts. (See appendix B.)

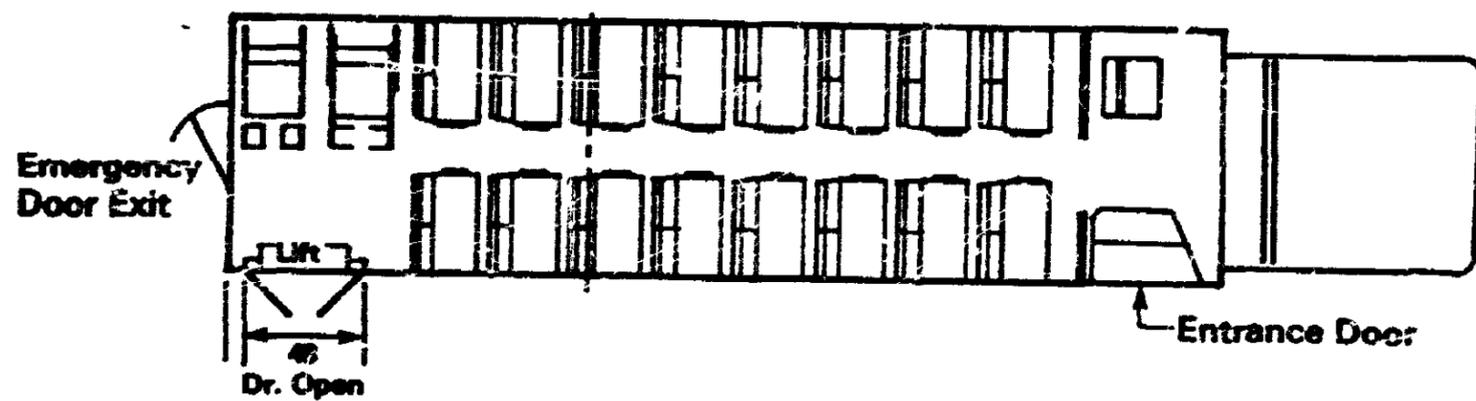
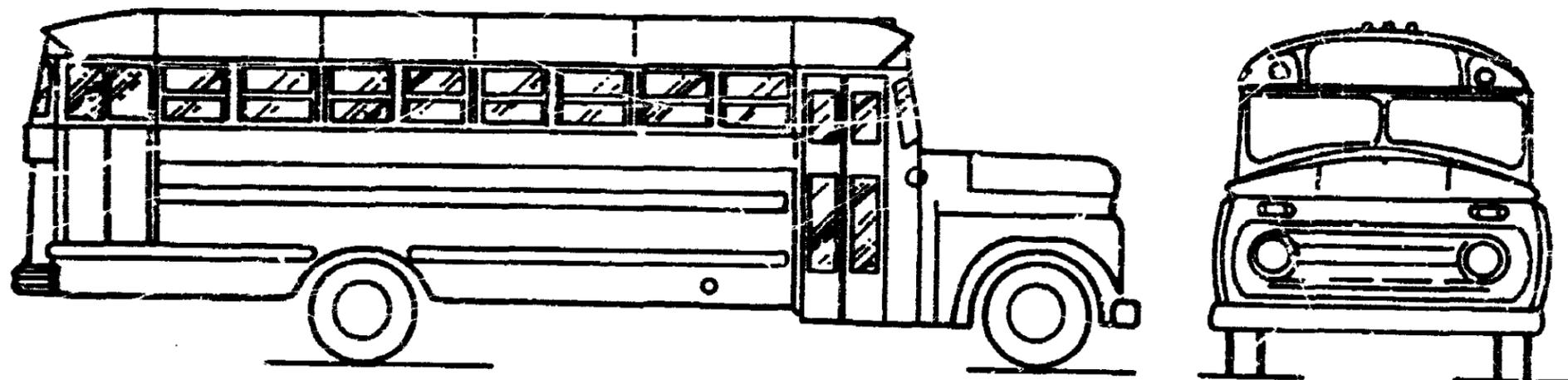


Figure 6.—Adult passenger bus.

The CWS bus was purchased by the New York State Department of Transportation (NYSDOT) under a grant program funded by the Urban Mass Transportation Administration (UMTA). The CWS bus was one of seven similar buses funded by the UMTA grant on which bids were received and a single contractor selected by NYSDOT. The award was made to the lowest bidder, the American Transportation Corporation, and the vehicle was delivered through Country Club Chevrolet of Oneonta, New York, a dealer for the American Transportation Corporation. (See appendix B.)

The NYSDOT purchased the buses under the Office of General Services Specification 40520-404, which cites New York's regulations for buses Part 720, which applies to "motor vehicles with seating capacity of not more than 16 passengers," and Part 721, which applies to "motor vehicles with seating capacity of more than 16 passengers." The accident bus was purchased under the specifications for part 721. To meet the regulation, buses are required to meet all Federal Motor Vehicle Safety Standards (FMVSS) applicable to buses; buses under the "schoolbus" 8/ specification must also meet these Federal standards applicable to schoolbuses. The buses purchased were, in the understanding of the NYSDOT and the contractor, not required to and did not meet FMVSS 221, School Bus Body Joint Strength.

Essentially, FMVSS 221 requires that both inside and outside panels of a schoolbus be fastened to other parts and to each other by joints which have at least 60 percent of the strength of the metal of the thinner panel which is joined. FMVSS 221 was made effective in 1977 and it resulted in a substantial increase in the overall structural strength of buses.

The NYSARC had sought to order the bus with flashing red lights and to have it painted schoolbus chrome yellow with black trim for added safety, but the request was denied by NYSDOT on the grounds that the passengers were not children and the vehicle was not to be used for school transportation purposes. 9/

The transportation director of CWS believed that CWS was purchasing a "regular schoolbus with some improved modifications," and he assumed that the bus had "the same structure value and requirements as a regular schoolbus." The purchasing procedures established by NYSDOT did not disclose to the end users all of the safety options available for the bus.

Major damage was observed on the front and left side of the bus. There was no evidence of smoke or fire damage. The left side of the front bumper was pushed inward 10 inches. The front axle had been severed from its chassis attachments during impact. The front wheels attached to the displaced axle were splayed outboard and the steering tie rod was buckled. Sheet metal panels on the left side were deformed inward from the driver's seat to approximately the fifth window. The window columns, windshield column, and the roof rails were substantially displaced inward during impact. The first window column behind the driver was pulled away and later found bent around the overhead ramp of the car-carrier semitrailer. The other three columns were broken loose at one end but remained attached to the bus. The rub rails were torn away when their rivets pulled out and were separated in multiple bends from the rub rail cap at the front. The rub rails

8/ 49 CFR 571.3 defines "schoolbus" as a "motor vehicle...designed for carrying more than 10 persons...that is sold, or introduced into interstate commerce, for purposes that include carrying students to and from school or related events..."

9/ Federal Highway Safety Program Standard No. 17 "Pupil Transportation Safety" clearly prohibits vehicles that are used wholly for purposes other than transporting pupils to and from school from being painted National Schoolbus Yellow Glossy, and having other safety equipment designated for schoolbuses (i.e. special lighting and lettering on bus to meet all Federal standards applicable to schoolbuses).

were not welded to the cap. They were pulled out axially, not sheared. All window assemblies on the left side, except for windows 5 and 6 from the front of the bus, were missing. The floor on the left side had buckled upward and inward. Maximum inward displacement was 18 inches between seat rows 4 and 5. (See figure 7.)

The exact amount of external damage resulting from impact on the left side could not be assessed. Rescue workers reportedly used hack saws and "Jaws of Life" extrication tools (Hurst Tools) to cut, bend, and remove about a 2-foot square section of sheet metal below windows 4 and 5 from the front of the bus. The right side of the bus body and floor were skewed rightward on the frame. The windows on the right remained intact. The right rear outer dual tire had 6-inch-wide horizontal scrape marks on the rubber surface. (The guardrail at the accident site was 6 inches wide.) The boarding entrance door was jammed closed.

The bus sustained multiple failures of joints between panels and joints of assembled sheet metal ahead of and above the driver. The driver's compartment was penetrated by a 10-inch portion of the upper end of the left windshield column and the separated interior surfaces of the roof cap. The failed joint between the roof cap and the first bow had half as many rivets as are used on similar buses manufactured to meet FMVSS 221. Two feet of the joint failed by pulling through rivet holes that were too close to the edge. Rivets which missed the panel were not defects because the bus was not required to meet any design or construction standard. The joint between the upper windshield and the windshield header failed adjacent to the column end, shearing rivets spaced at an interval three times wider than that in the FMVSS 221 bus. Interior structure panel joints between the roof and the roof cap failed where rivets were spaced two to three times farther apart than that observed in the FMVSS 221 bus. A two-row riveted joint which supported the rail beside the driver had half as many rivets as the FMVSS 221 bus, but rivets of one row had failed to engage the panel over a 14-inch length. Four rivets were placed where the FMVSS 221 bus had 14 rivets. The left windshield column split through a joint having spotwelds on a 3 1/2 inch spacing where a similar windshield post of a truck cab would have a one-inch spacing.

The right rear of the bus was pushed inward when it contacted the tree that was 15 feet from the guardrail. Wood was imbedded in the bus body and its supporting chassis in the same area. The rear emergency door was jammed closed. The top of the door was pushed inward about 4 inches, and the bottom of the door was pushed outward about 3 inches at the frame.

The interior of the bus was severely damaged. The left side wall adjacent to the driver's seat was pushed inboard about 1 foot, and the roof line was deformed downward about 1 foot. The steering wheel was deformed into an elliptical configuration with blue transfer marks on its outside surface. The driver's seat frame was bent rearward about 18 inches and was found resting on the modesty panel behind the seat. The seatbelt assembly was undamaged; however, because of other seat damage, it could not be determined if the driver's seatbelt was being used at the time of the accident.

Although the bus routinely carried mobility assist devices (walkers, canes), there were no provisions to restrain the devices and they were stowed in empty seats or in the rear of the bus.

At least six seat assemblies were partially or completely separated from either their floor or sidewall anchorages (see figure 7). Several seat assemblies were displaced forward and inward during the impact sequence, which caused the attaching seatback and

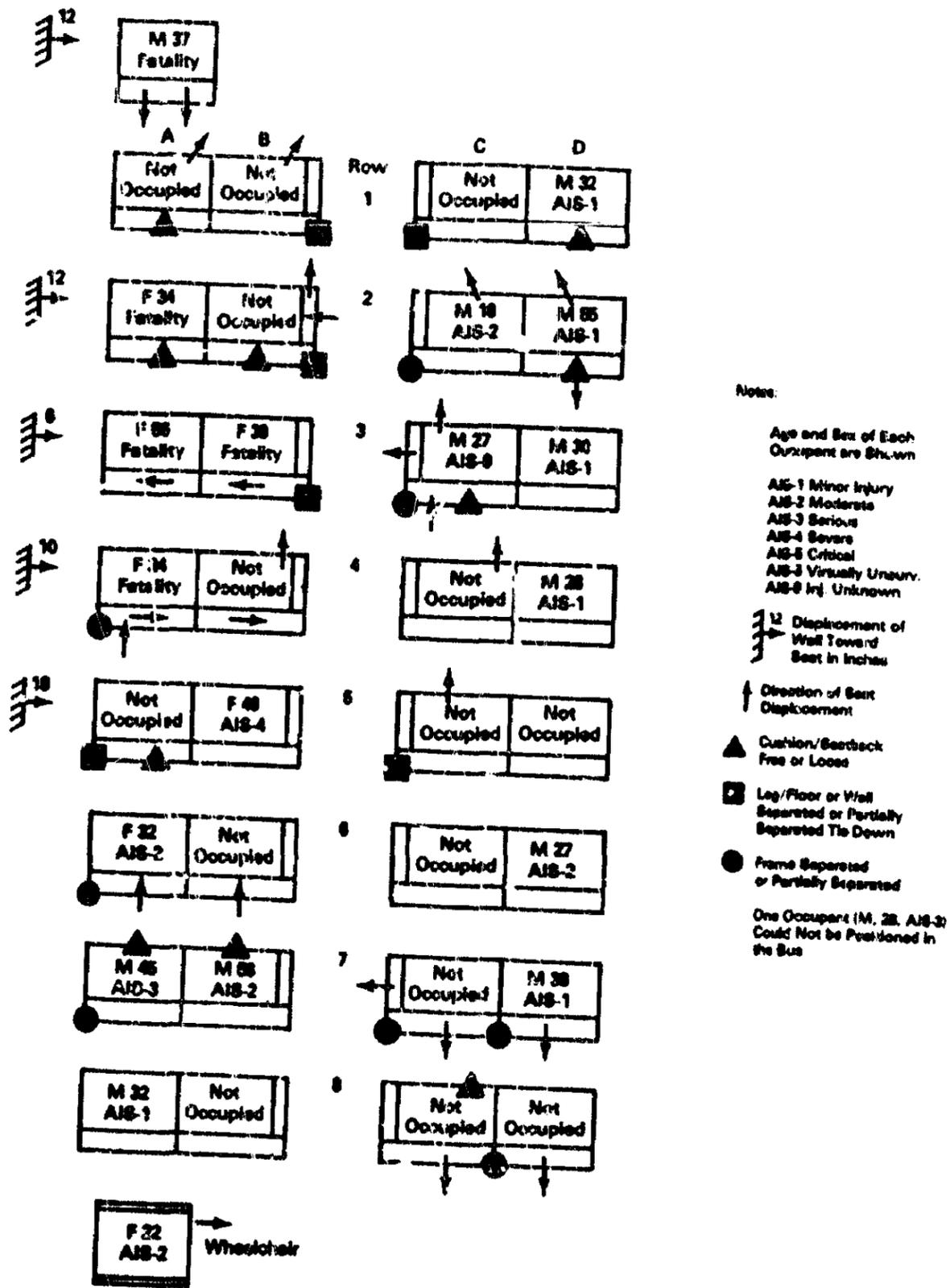


Figure 7.—Bus occupant seating chart depicting age, sex, and AIS injury level of the occupants, and wall displacement and seat damage to bus.

seat cushion to separate from their respective seat frame. The impact penetration on the left side caused two seat units (4A and B, and 5A and B) to shift laterally, thus blocking the center aisleway in the passenger compartment.

Driver Information

Combination Vehicle.—At the time of the accident, the 28-year-old driver of the tractor car-carrier semitrailer held a valid New York State Class 1 driver's license with no restrictions. According to the Norwich Sheriff's Department, the driver had been convicted of one traffic violation, "moving from a lane unsafely," in December 1978.

The driver's logs for April 4 and 5 were destroyed in the postimpact fire. His carrier estimated that his total driving and on-duty (non-driving) times for April 4 and 5 were 5.5 hours and 7.5 hours, respectively. From March 29 to the time of the accident, the driver had accumulated 47.5 hours (driving and non-driving). He had been off duty on April 2 and 3. The driver was traveling empty en route to the carrier's Wellesley Island, New York, terminal when the accident occurred.

Flatbed Truck.—At the time of the accident, the 28-year-old driver of the flatbed truck, who was a resident of South New Berlin, New York, held a valid New York State Class 3 driver's license with no restrictions. According to the Norwich Sheriff's Department, he had been convicted in 1977 for "failure to keep right." Although the driver's employer would not supply the Safety Board's investigators with the driver's employment history, it was learned that the driver had been driving this type of vehicle for about 2 years and that he had no formal training regarding towing procedures. As a result of this accident, the driver was initially charged with being in violation of two traffic infractions, "failing to have an SMV emblem on the rear of a slow-moving vehicle" and "using an unauthorized tow hitch." He was later convicted of only the "unauthorized tow hitch" charge and released on a conditional discharge. ^{10/} No fines or other civil penalties were assessed, and no charges were brought against the Valley Supply Company.

Bus.—At the time of the accident, the 38-year-old driver of the CWS bus held valid New York State Class 2 and Class 4 driver's licenses with no restrictions. According to the Norwich Sheriff's Department, the driver had not been convicted of any traffic violations.

The driver had been employed as a part-time driver by the CWS for about 5 years. He had been employed previously as a transit tour busdriver. The driver's typical day began about 5:30 a.m., when he started his run to pick up the CWS clients and transport them to their jobs at the CWS. After finishing his morning run about 7:30 a.m., he would return home and typically spend the day at home (he did not have another job). His afternoon run to return the clients to their homes began about 3:15 p.m. and usually ended about 5:15 p.m. The driver traveled about 50 miles and made 15 stops during each run. On the day of the accident, the driver had made one stop before reaching the accident location.

^{10/} Conditional discharge: As a result of being found guilty of non-criminal charges, the judge may impose certain conditions that the defendant must perform. These conditions can be community service, work, certain requirements for operating a motor vehicle, etc.

According to the driver's employer, the driver had not complained of fatigue or illness. The driver's last absence from work because of illness was during the previous winter when he was absent for 2 days because of the flu. Although there were no instructions from CWS to do so, it was reported by CWS officials that the driver habitually wore his seatbelt while driving the bus. It could not be determined if the driver was wearing his seatbelt during the accident.

Highway Information

The accident occurred on State Route 8 about 1.5 miles south of Holmesville, New York. New York State Route 8 is a Federal aid, primary (other than Interstate) rural highway which is aligned in a north-south direction from Deposit, New York, to Utica, New York. In the area of the accident, State Route 8 is a two-lane, two-way road paved with an asphalt concrete mix. The road is almost 22 feet wide with 5-foot-wide northbound and southbound shoulders. In the southbound direction, a no-passing zone marking consisting of a solid yellow line and a broken yellow line began about 800 feet north of the site. At a point about 370 feet north of the accident site, the centerline changes to a double yellow line, which continues to a point about 1/2 mile south of the accident site. The lanes are bordered by a solid white edgeline on each side. At the time of the accident, the markings were in good condition.

Initial impact occurred on a 1° 30' (3,819.8-foot radius) right curve, traveling southbound. The design speed of the curve was 60 mph. The unposted speed limit at this location was 55 mph. In the southbound direction of travel, the grade is +0.4 percent.

The estimated 1980 average daily traffic was reported to be 1,200. No measurements were made on the horizontal sight distance; however, NYSDOT personnel estimated the horizontal sight distance to be 800 feet for northbound vehicles and "unlimited" for southbound vehicles.

The guardrail located on the edge of the southbound shoulder was the New York box-beam type (AASHTO design G3), 11/ and was installed at this location in 1975 at a 30-inch design height (top of rail).

The box-beam design is considered a semi-rigid barrier. Resistance is achieved through the 6-inch-square section of rail which provides flexure and tensile stiffness. The posts near the point of impact were designed to break or tear away; the forces of impact are distributed through the beam to the adjacent posts.

The box-beam guardrail is not designed to redirect or contain large trucks and heavy vehicles. However, a NYSDOT research report indicated that the box-beam has "performed well" when struck by commercial vehicles. 12/

11/ American Association of State Highway and Transportation Officials Guidelines for Selecting, Locating, and Designing Traffic Barriers, 1977, p. 37.

12/ In 1965, NYSDOT conducted one test with a 6-inch by 6-inch box beam and a 15,000-pound 1954 International truck. The truck was equipped with a special "box beam bumper." Impact occurred at a 45° angle with the truck traveling at 45 mph. According to NYSDOT, the barrier performed well. In 1968, NYSDOT began a series of additional tests to study the practical aspects of the design, construction, and maintenance of highway barriers. The results are published in a 1978 NYSDOT report - Report 38, "Testing of Highway Barriers and Other Safety Accessories." Analysis of this testing resulted in several changes which later were adopted by NYSDOT in the box-beam design. The NYSDOT Research Report 57, which reviewed actual accident data, concluded that the box-beam guardrail performed well when impacted by vehicles larger and smaller than standard sedans.

According to information supplied by the NYSDOT, no other accidents occurred at the accident location during the period from January 1, 1977, to October 31, 1982. The nearest location with an accident history was 0.20 miles north of the accident site. Two accidents occurred during the aforementioned period, one of which was classified as nonreportable. 13/

The asphalt concrete mix used to pave this highway is considered by the NYSDOT to have good skid resistant qualities. Although no tests were made on this route, NYSDOT skid-trailer tests made on other highways in the area with the same type pavement indicate a wet tire-to-pavement friction value of over 0.40, which is considered good for wet pavement conditions.

Physical Evidence

Safety Board investigators observed tire marks and gouges in the pavement surface at the accident site (see figure 1). Four tire skidmarks from the right and left dual tractor tires of the car-carrier combination vehicle were observed in the northbound lane. These marks were slightly curvilinear, following the circumference of the 1° 31' curve. The longest mark was 154 feet. Scuff marks from the left front tire of the tractor began about 8 feet north of where the left dual skidmarks ended. Scuff marks from the right front tire of the tractor began farther north of the point where the right skidmarks of the trailer ended and on the edge of the right lane. These marks continued in a left curve of a continually decreasing radius to the point where the tractor came to rest. The tractor came to rest in the southbound lane facing west approximately perpendicular to the centerline of the highway. The semitrailer jackknifed, separated from the tractor, and came to rest skewed at a right angle to the tractor with its rear crossing the centerline.

Following the impact with the tractor the bus contacted the guardrail on the shoulder of the roadway and pushed it 15 feet west of its original position. The bus came to rest against the guardrail and a tree. During impact, the front axle of the bus separated from the bus and came to rest about 27 feet south of the right front corner of the bus. Green paint transfers were found on the box-beam guardrail about 25 feet north of where the tractor dual skidmarks ended. The plow came to rest in the southbound lane about 15 feet north of the point where the left dual skidmarks of the tractor ended. A deep gouge, approximately 5 feet long, was observed in the pavement of the southbound lane about 4.5 feet from the highway centerline.

Meteorological Information

Weather observations were obtained from a national weather observer who resided in Norwich, New York, about 7 miles west of the accident site. The observer's weather station is located in a valley adjacent to the accident site and the observations should be indicative of the conditions at the site. At the time of the accident, the weather was reported to be cloudy with the temperature about 48° F. The accident occurred during daylight hours at approximately 3:40 p.m. There was no precipitation during the 14-hour period between 7:00 a.m. and 9:00 p.m. on the day of the accident. The pavement was dry at the time of the accident.

13/ A nonreportable accident, according to the NYSDOT, involves property damage only. During the accident analysis period (January 1, 1977 to October 31, 1982), this amount was increased from \$200 to \$400.

Medical and Pathological Information

The busdriver and four bus passengers sustained severe traumatically induced injuries. The coroner's report attributed the cause of death for all five fatal victims to massive head injuries sustained during the crash. Except for one passenger, who died later during the evening of the accident, autopsies were not performed on any of the fatalities.

The busdriver sustained a cervical fracture, occipital and basal skull fractures, a fractured jaw, bilateral rib fractures with upward displacement of internal organs, and anterior throat lacerations. There was no evidence of other medical problems which might have caused incapacitation.

Five bus passengers, who remained hospitalized after the accident, sustained respectively: (1) a fractured right clavicle and severe facial and right eyelid lacerations; (2) ruptured spleen; (3) various fractures of the face and lacerations to the right scalp; (4) skull fracture; and (5) fracture of left coracoid process and fracture of the transverse process T-2 vertebra. (See appendix C for further details on passenger injuries.)

Four passengers, who were hospitalized and released on April 6, 1983, and six passengers, who were treated and immediately released, sustained various degrees of contusions, abrasions, and lacerations.

The driver of the car-carrier semitrailer sustained a fractured left fibula, tibia, and femur and a deep laceration to the left foot. The driver of the flatbed truck was not injured.

Survival Aspects

The busdriver's seat and wheelchair positions were equipped with seatbelts. The passenger seats were not equipped with seatbelt restraints, nor were they required to be. The tractor car-carrier semitrailer struck the bus on the left front and side and penetrated rearward into the driver's seat and the passenger compartment on the left side. The occupant of the most forward wheelchair position was restrained during the accident.

In the first four rows of seats on the left side of the bus, the seats had partially separated from their floor or sidewall anchorages, and arm rests had separated from seats. Many of the seatbacks in this area were pushed rearward from impact with the tree and inward during the impact with the truck. Blood was observed at various locations on the seats and seatbacks on the right side of the bus. Figure 7 contains the seating positions and AIS injury levels ^{14/} of the bus occupants.

The investigation disclosed that there was no protective padding on hard environmental surfaces at the two wheelchair stations and none was required by the State of New York. The investigation also disclosed that the padding which covered the tops of the passenger seats could be easily compressed by hand until the metal seat frame was contacted. There was no protective padding over the rear surfaces of the seat backs.

The tractor car-carrier semitrailer was equipped with a seatbelt on the driver's seat. Because of a fire which erupted and destroyed the cab moments after the driver had been extricated from the cab by a nearby resident, it could not be determined if the

^{14/} Abbreviated Injury Scale, developed by a joint committee of the American Medical Association, the Society of Automotive Engineers, and the American Association for Automotive Medicine to characterize the degree of highway accident injury.

truckdriver was wearing his seatbelt at the time of the accident. The resident does not recall releasing the driver's seatbelt.

Other Information

Manufacturer's Safety Warnings on Transporting the Plow.--The following information regarding the transporting of the plow is contained in the manufacturer's purchase manual:

These plows have been designed to be transported at a maximum speed of 20 mph. DO NOT EXCEED.

Never travel at any speed which does not permit adequate control of steering and stopping.

CAUTION: When transporting the plow on a road or highway at night or during the day, use accessory lights and devices for adequate warning to operators of other vehicles. In this regard, check local governmental regulations for proper use.

Your plow is equipped with a slow-moving vehicle emblem for warning to the operators of vehicles approaching from the rear. Keep this emblem clean.

Applicable State Law Regarding Towing.--The State of New York Vehicle and Traffic Law (VTL) (1982 edition) contains the following information:

Section 375.1

Every trailer while being drawn upon the public highways of this state shall be so attached to the vehicle drawing the same as to prevent the wheels of such trailer from being deflected more than six inches from the path of the towing vehicle's wheels. On and after January first nineteen hundred seventy-one every trailer, except a semi-trailer, while being drawn upon the public highways of this state, shall be attached to the vehicle drawing the same by a device of a type approved by the commissioner of motor vehicles.

Section 375.29a.

No vehicle shall be towed with the use of a dolly unless the dolly is secured to the towed vehicle by safety chains or cables which will prevent the dolly from separating from the towed vehicle.

Dolly shall mean a multi-wheel device utilized by the tow truck operators to tow vehicles due to damage or mechanical failure, which are incapable of being towed on their own existing wheels. 15/

15/ Section 375.29a as written is not expressly applicable to farm equipment or general trailers in tow.

The Society of Automotive Engineers (SAE) J697a ^{16/} "Safety Chains of Full Trailers or Converter Dollies" recommends the following practice for users of full trailers or converter dollies:

A safety chain shall be attached and installed so as to keep the trailer in a straight line back of the towing vehicle insofar as practicable in event of failure of the drawbar connection or coupling device.

The safety chain shall have no more slack, when in use, than is necessary to permit proper turning of the vehicles.

ANALYSIS

General

The busdriver, the driver of the flatbed truck, and the driver of the combination vehicle held valid operator permits for the types of vehicle they were respectively operating. Because of vehicle damage and the postimpact fire, Safety Board investigators were not able to measure slack adjustments for the service brakes of the combination vehicle to determine if any preaccident mechanical deficiencies existed in the brakes. However, the skidmarks present in the northbound lane indicate that the combination vehicle's service brakes were functional just before the impact with the plow. Witness observations further indicate that the combination vehicle had been operating in a safe manner up to the point where the accident occurred. The post-crash inspection did not reveal any other mechanical deficiencies which might have caused the truckdriver to lose steering control of his vehicle immediately before impact with the plow. Weather was not considered a factor in this accident. There is no medical evidence of impairment or incapacitation of any drivers involved in this accident.

The Accident

The adult monitor onboard the CWS bus stated that the busdriver had reduced speed because the plow in tow ahead was moving laterally in its lane of travel. A motorist who was following the bus indicated that she had not passed the bus because she also had seen the plow moving laterally in its lane of travel. Based on this motorist's statement that her vehicle and the bus were traveling between 35 and 40 mph just before the accident, the Safety Board concludes that the flatbed truck was traveling at a speed of at least 35 mph before the accident.

The manufacturer warns, in its purchaser's manual, that the plow was designed to be transported at a maximum speed of 20 mph and that this speed should not be exceeded. The plow had been observed swaying in its lane of travel for some time. Had the flatbed truckdriver been traveling at a lower speed, it is very likely that the plow's lateral movement would have been substantially reduced. If the plow's lateral movement contributed to the dolly's coming unhitched due to excessive horizontal/vertical movement of the crossbar within the hitch attachment, a reduced speed resulting in reduced movement of the plow could possibly have prevented the accident. It is possible that the hitch latches may not have been properly closed before the towing began. There was no evidence of damage or mechanical malfunction observed on the hitch. If the manually operated spring latches were not in the closed position before being transported, then the farm plow could easily have unhitched itself and separated from the towing dolly. Under this condition, the kinetic energy of the farm plow is crucial because it

^{16/} SAE Recommended Practice J697a, Section 37.20 of the SAE Handbook, published 1981.

is directly proportional to the square of the speed. The higher speed increased the kinetic energy that had to be dissipated, and made it possible for the plow to overcome pavement frictional drag and move into the opposing northbound lane directly in the path of the combination vehicle. Thus, the Safety Board concludes that if the flatbed truckdriver had been traveling at a sufficiently low rate of speed, the accident may not have occurred.

According to a motorist who was traveling ahead of the tractor car-carrier semitrailer (combination vehicle), the combination vehicle was traveling about 50 mph just before reaching the accident site. Although the driver of the combination vehicle had an 800-foot sight distance, the flatbed truck was in a shallow right curve that might have obstructed the combination vehicle driver's view of the plow in tow. The driver of the combination vehicle was confronted suddenly with a plow in his lane of travel. He reacted by making a hard brake application, but impact was inevitable. The Safety Board calculates that the truckdriver slowed his vehicle to about 20 mph before striking the errant plow. As a result of impact, the left front tire ruptured, which caused the truckdriver to lose steering control of his vehicle and placed him on an unavoidable collision path with the bus. There was no further action the driver of the combination vehicle could have taken to avoid the collision, and the operation of his vehicle was not considered a factor in this accident.

Likewise, the busdriver was placed in a situation in which he had little time and distance to react to avoid the collision with the combination vehicle. The busdriver's actions prior to the accident indicated that he had recognized the possible danger of the swaying plow and had reduced speed to increase the distance between his vehicle and the plow.

Towing of Farm Equipment

The manufacturer of the plow equipped the plow with a slow-moving vehicle (SMV) emblem to warn operators of vehicles approaching from the rear and urged that this emblem be kept clean. State law requires that a SMV emblem be displayed on the rear of farm equipment that is operating at speeds of 25 mph or less on public highways. The Valley Supply Company, Inc., the company towing the plow at the time of the accident, stated that the plow did not display the SMV emblem at the time of the accident. Although the farm plow was being towed at a speed in excess of its design speed, the farm plow was not required by State law to have an SMV emblem on the rear since it was being towed on the public highway at a speed above 25 mph. Because of the tracking alignment problems associated with towing farm equipment on public highways, the management policy of the Valley Supply Company, Inc., should have required that a separate delivery trip be made with the accident farm plow anchored on top of the flatbed truck, or that the farm plow be towed at a speed which would permit the farm plow to safely track behind the towing vehicle.

Section 375.1 of the New York State VTL requires every trailer which is operated on public highways after January 1, 1971, to be attached to the towing vehicle so as to prevent the wheels of such trailer from being deflected more than 6 inches from the path of the towing vehicle's wheels. In addition, every trailer, except semitrailers, shall be attached to the towing vehicle with a device that is approved by the State, as required by State law. The dolly and quick coupler device involved in this accident were not approved by the State, as required by State law, and the combination of the device and the farm plow in tow did not meet the maximum deflection requirement established in Section 375.1 for trailers. As a result of this accident, the driver was charged with being in violation of Section 375.1 (see page 30), convicted, and then released on a conditional

discharge. No fines or other civil penalties were assessed, and no charges were brought against the Valley Supply Company.

Given the size of the farm equipment, the design of the dolly, and the type of hitch attachment, the owner/operator should have secured the plow and dolly to the truck to preclude separation in transit. A fairly easy approach would have been to attach safety chains between the plow and the dolly and between the dolly and the flatbed truck. This safety practice is a recommended procedure established in SAE J 697a for users of full trailers or converter dollies. Safety chains probably would have kept the plow in its own lane or at least minimized its intrusion into the opposing lane.

Section 375.29a of the New York State VTL requires each dolly that is used by a tow truck operator for transporting inoperable motor vehicles to be secured with safety chains or cables. However, the law as written does not apply to a dolly used for transporting implements of husbandry (i.e., farm equipment) or off-highway use vehicles. Section 375.29a should be amended expressly to require the use of safety chains, cables, or other redundant devices with any dolly that is used to transport any vehicle on a public highway that is incapable of being towed on its own wheels.

Survival Aspects

The Safety Board concludes that the busdriver would not have survived this accident even if he had been wearing his seatbelt. Initial impact occurred between the left front of the bus and the left front of the car-carrier tractor. The left side of the bus was penetrated primarily by the tractor and the tractor's overhead ramp. The sharp profile overhead ramp initially struck the driver's area and continued rearward into the passenger compartment. As the overhead ramp severed through the upper portion of the left side of the bus, the tractor also continued to penetrate rearward into the lower left side of the bus. The driver and passengers seated in the impact area were subjected to extremely high collision forces and sustained multiple penetrating, crushing, blunt force injuries. The structure of the busdriver's compartment did not prevent intrusion during the impact; the front of the bus was pushed inward, the compartment's roof was buckled downward, and the driver's seatback was displaced rearward. The type and location of the busdriver's injuries indicate that trauma was inflicted during penetration of the operator's compartment. Similarly, the four passenger victims, who were seated on the left side of the bus, incurred their fatal injuries during penetration of the passenger compartment. These passengers probably would not have survived the accident even if they had been restrained by seatbelts. Four seats on the left in the impact area were unoccupied, and had they been occupied during the accident, the passengers in those seats potentially might have received fatal injuries.

Injuries incurred by the surviving passengers were a result of contact with the interior surfaces--seatback frames, seatback support ramps, windows, side walls, and arm rests, during the initial impact and the bus's subsequent contact with the guardrail and the tree. The investigation showed that although the tops of the seatbacks were padded the material could easily be compressed down to the hard underlying frame. The seatback support pans, which were in front of each passenger, were flat, hard, and unyielding and were within the strike envelope of many of the passengers' head/trunk area. If seatbelts had been used, the passengers would have hit the seatbacks and adjacent environmental surfaces. Although seatbelts might have had a marginal effect in mitigating some of the minor injuries, padding or better padding of the interior surfaces around and in front of the passengers would have been effective in reducing some of the lesser lacerations, abrasions, and contusions.

The CWS had no current policy concerning the use of seatbelts by busdrivers on official duty. Reportedly, the driver of the accident bus habitually wore his seatbelt when operating the vehicle. Even though the use of a seatbelt would not have prevented the driver from receiving fatal injuries in this accident, it is important that all drivers wear the seatbelt that is provided whenever the bus is moving. The ability to maintain control of the bus in an emergency or crash situation is seriously jeopardized if the driver is thrown from the seat. In a 1972 crash in Virginia, 17/ a car ran a stop sign and hit a large schoolbus. The bus ran off the road and partially overturned. All the bus occupants were injured. The Board found that "the second collision of the bus, into the embankment, was caused by loss of driver control; the nonuse of available seatbelts by the driver prevented the regaining of control." Thus, CWS should require its drivers to wear their seatbelts whenever the vehicle is in motion.

When purchasing buses, especially for transporting mentally and physically handicapped persons, any government agency should explicitly consider the safety implications of any deviation from the minimum Federal standards for schoolbuses built after April 1977. Because of their physical and developmental impairments, the occupants in the accident bus were not able to protect themselves from secondary impacts with interior items (e.g., seats). With some purchases, the number of model/options combinations available to the purchaser may need to be limited in order to ensure that selected options do not jeopardize the overall occupant protection provided in the vehicle. For example, the accident bus was purchased with transit type seats to accommodate adult passengers. Several passengers were injured as a result of contact with these seats. Possibly, some of these low level injuries (AIS level 1 and 2) could have been mitigated by selecting padded seats (similar to those required for post-1977 schoolbuses) in lieu of the transit type seats. The post-1977 schoolbus seats are designed to absorb energy through controlled yielding. Similarly, in cases where the bus is modified, for example, to provide for wheelchair stations, the environmental surfaces at these stations should be adequately padded. The CWS ordered some options it considered to be safety related, such as air brakes and warning buzzers to indicate if the rear windows or doors were ajar.

Postcrash rescue attempts were enhanced by the fact that the bus remained upright after the collision (this was due in part to the boxbeam guardrail absorbing most of its kinetic energy as the bus came to rest). There was daylight to illuminate the inside of the bus, and there was no panic among the survivors. However, timely removal of the occupants was adversely affected by the conditions of the exits at the time of the accident, and had the fire from the tractor propagated to the bus (fuel was found on the ground near the bus and on the bus), the consequences of this accident could have been even more catastrophic.

The main door was damaged and jammed closed as a result of the initial impact, and the stairwell was blocked by the body of the busdriver. Passengers were unable to evacuate the bus through this exit. The rear door was jammed closed when the bus contacted and came to rest against a tree and consequently could not be used to evacuate the bus. The rear door was placarded as an emergency exit on the inside of the bus, but not on the outside of the bus. Although the circumstances of this accident precluded the use of the rear door as an evacuation route, emergency exits should be placarded both on the inside and the outside of the bus to inform emergency response personnel of all possible evacuation routes.

17/ Highway Accident Report--"Schoolbus-Automobile Collision and Fire Near Reston, Virginia, February 29, 1972" (NTSB-HAR-72-2).

Removal of the bus occupants through the emergency exit windows was greatly hampered by the type of emergency exit windows that were installed in the bus. The four 26-pound emergency exit windows on the right side were hinged to the bus at the top of the windows. There were no means to hold these windows open during rescue efforts, and rescue personnel attempted unsuccessfully to remove the hinges to facilitate evacuation of the passengers. ^{18/} Emergency exit windows should include a simple and reliable means to keep the windows open during emergency rescue attempts. This accident suggests that bus manufacturers should consider alternative window designs to resolve this problem.

The wheelchair ramp door, which was located in the right rear of the bus, was placarded on the outside of the bus as an emergency exit. The doorway was not a two-way exit and could not be opened from the inside. The elevator ramp inside the doorway had to be lowered to permit occupants to exit easily. When electrical power was off, the ramp must be lowered by a manual control, which was located inside the bus and not accessible from the outside. Thus, a rescue person would find it extremely difficult to lower the ramp for evacuation purposes. Although specific instructions on the operation of the hydraulic controls would have enhanced the evacuation efforts, a wheelchair ramp door does not constitute an emergency exit.

The CWS bus was used to transport medically and physically handicapped persons to and from the Work Shop. There was no placard on the outside of the bus to indicate that the bus was carrying handicapped persons and there is no requirement for this type of bus to have such a placard. Although the lack of such a placard did not affect rescue attempts in this accident, the Safety Board believes that it would be prudent for buses which routinely carry handicapped persons to display such a placard to alert rescue personnel to the fact that some of the bus occupants may have mobility impairments and may need special assistance evacuating the bus.

Purchasing of Community Work Shop Bus

Since the bus was not classified as a schoolbus by NYSDOT, it was not required to meet the Federal Motor Vehicle Safety Standards (FMVSS) applicable to schoolbuses, in particular FMVSS 221 which required that both inside and outside panels of a schoolbus be fastened to other parts and to each other by joints which have at least 60 percent of the strength of the metal of the thinner panel which is joined. However, the director of the CWS believed that the bus was a "schoolbus with some improved modification" and that the bus had the same structural requirements as a schoolbus. The purchasing specifications established by the NYSDOT did not disclose to CWS all of the available safety options that could be ordered.

Most of the CWS bus structure below the window sills probably met the strength requirements of FMVSS 221 given the design similarity between this part of the bus and one manufactured to meet the requirements of FMVSS 221. However, Safety Board investigators observed several failed joints in the body structure above the windows, particularly at the front of the bus. In some cases, the rivet spacing on panel members near the driver's seat was three times wider than on buses which meet the requirements of FMVSS 221. In two of the failed joints, a large number of rivets also were placed too close to the edge of the panel to be effective and many of the rivet holes did not engage the adjoining panel as intended by the design. There were also fewer spotwelds connecting windshield members at the front columns of the bus. Failure of these columns

^{18/} Attempts to remove the hinges were abandoned after rescue personnel were delayed in finding a "Phillips Head" screwdriver and then in being able to reach the hinges which were about 8 feet above the ground.

led to the jamming of the right side door at the front of the bus and considerable intrusion of the driver's area. If the number of rivets or spotwelds used to assemble body panels or columns is reduced, then the strength of the body structure is reduced.

The mode of failure of the joints indicated that the upper structure of the bus was substantially weaker than the lower structure and that poor construction practices were used during the bus body assembly. Although the joint discrepancies were noted, it could not be determined if improved body construction techniques would have reduced the level of injuries in this accident because of the severity of the collision forces.

A stronger bus, such as one manufactured to meet the requirements of FMVSS 221, theoretically might have offered more structural resistance to reduce inward sheet metal deformation; however, the high collision forces transmitted to the occupants seated in the impact area probably would have caused the fatal injuries regardless of the deformation observed as a result of intrusion. This is evidenced by the fact that all of the fatal occupants (seated in rows 1 to 4) were forward of where maximum inward displacement was measured in the bus. The passenger seated in the area where maximum inward intrusion occurred did not receive fatal injuries. Thus, the consequences of this accident would not have been different had the bus involved met the FMVSS 221 requirements.

The Safety Board is concerned that CWS was not fully knowledgeable of the type of bus that was being purchased for its use. The CWS believed that the structural integrity of the bus it was purchasing was similar to that of a schoolbus. CWS had requested certain safety features which were provided. If it had been offered the option of structural integrity similar to that required by FMVSS 221, CWS most likely would have requested the option. The misunderstanding could have easily been resolved had NYSDOT simply provided a copy of the purchase specification order to CWS. Nevertheless, the Safety Board believes that the NYSDOT should review its procedures for purchasing transportation equipment using State or Federal assistance for small community organizations to assure that all interested parties are well informed of the type of vehicle being purchased.

The occupant protection and vehicle crashworthiness requirements specified by Federal standards for schoolbuses provide a minimum level of protection and are not required for other buses. However, incorporation of these requirements into schoolbus-type vehicles being used for other passenger transportation is not prohibited and should be encouraged.

Emergency Response

The Safety Board has long supported the establishment of mutual aid agreements among adjacent communities to assure adequate and quick response to emergency situations. Once the first emergency response person arrived on-scene to assess the situation, he implemented the automatic mutual aid response agreement between the four county area. Ambulances were requested and dispatched from two counties. Hospitals in three counties were notified to activate their disaster plans, and that they would be receiving injured persons. Injured persons were taken to all three hospitals. Although more than 100 fire, police, and emergency response personnel were on-scene, the traffic and crowd control was orderly, the accident scene was adequately secured, and the emergency response personnel arrived in a timely manner. This accident illustrates the effectiveness of coordinated and preplanned agreements. The Safety Board acknowledges the efforts of the local residents in their effective emergency response to this accident.

CONCLUSIONS

Findings

1. The weather was not a factor in this accident.
2. Each driver held a valid operator permit for the type of vehicle he was operating.
3. There was no evidence of impairment or incapacitation of the busdriver, the car-carrier driver, or the flatbed truck driver.
4. The tractor car-carrier semitrailer was operated in a safe manner prior to impact with the errant plow.
5. The driver of the flatbed truck was towing the plow at a speed in excess of its design speed, contrary to the manufacturer's warning.
6. If the flatbed truckdriver had been traveling at a lower rate of speed, the accident might not have occurred.
7. The busdriver observed the lateral movement of the plow in its lane of travel ahead of him and took precautionary measures by reducing his speed, thereby increasing the distance between his vehicle and the plow.
8. Because of the limited time and distance after the errant plow entered his driving lane, there was no further action the driver of the tractor car-carrier semitrailer could have taken, beyond the braking that he did, to avoid impact with the plow. Similarly, there was no action the busdriver could have taken to avoid impact with the car-carrier semitrailer.
9. Because of the penetration into the passenger compartment, it is doubtful that the driver and the four passengers who died would have survived the accident even if they had been restrained by seatbelts.
10. The rear door was placarded on the inside of the bus as an emergency exit, but was not so placarded on the outside. The lack of an emergency exit placard on the outside of the rear door, however, was not a factor in this accident, because the rear of the bus came to rest against a tree and consequently the rear door could not be used as an emergency exit.
11. Attempts to evacuate passengers through the emergency exit windows were hampered by the type of windows installed on the bus.
12. The wheelchair ramp door was incorrectly labelled "emergency exit" on the outside of the bus. However, the door could not be opened from the inside.
13. The accident bus, which routinely carried handicapped persons, did not display an appropriate placard to alert rescue personnel to the fact that some of the bus occupants may have mobility impairments and may need assistance to evacuate the bus.

14. The farm plow was not required to display a slow-moving vehicle emblem when towed on a public highway at a speed above 25 mph.
15. The dolly and quick coupler device involved in this accident were not approved for use by the State of New York, as required by State law.
16. Safety chains might have kept the plow in its lane of travel or at least minimized its intrusion into the opposing lane.
17. The bus was not classified as a schoolbus by the New York State Department of Transportation.
18. Some of the low level injuries sustained by bus occupants could have been mitigated by selecting padded seats (similar to those required in schoolbuses) in lieu of transit type seats.
19. There was no protection from secondary impact injuries for occupants at the wheelchair stations.
20. The consequences of this accident would not have been different had the bus involved met the Federal Motor Vehicle Safety Standard 221 requirements.
21. Most of the bus structure below the window sills probably met the requirements of Federal Motor Vehicle Safety Standard 221; however, the upper bus structure was substantially weaker due to fewer fastenings and poor design and workmanship. This reduced the joint strength integrity of the bus body panels.
22. The purchasing specifications established by the New York State Department of Transportation did not disclose to the Community Work Shop all of the available safety options that could have been ordered for this bus.
23. Incorporation of the occupant protection and crashworthiness requirements specified by Federal Standards into schoolbus-type vehicles being used for other passenger transportation is not prohibited and should be encouraged.
24. Mutual aid agreements were implemented which resulted in quick and adequate response to the emergency.

Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the towing of a farm plow on a highway at a speed which did not permit the farm plow to track properly behind the flatbed truck and the use of an unapproved tow hitch device. Contributing to the cause was the failure to use safety chains to preclude vehicle separation in the event of a tow hitch failure. Contributing to the severity of injuries of some of the bus passengers was the lack of effective occupant protection from secondary impacts with interior surfaces.

RECOMMENDATIONS

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

--to the New York State Department of Transportation:

Revise, if necessary, your procedures for purchasing special-purpose buses to provide end users full information about the types of vehicles and the safety options available. Provide the end user with a copy of the agreed-upon purchase specifications. (Class II, Priority Action) (H-84-5)

Require that all emergency exits are properly labeled both on the interior and exterior of special-purpose buses, and that these exits are readily accessible exits. (Class II, Priority Action) (H-84-6)

Install placards on the front, rear, and sides of mass transportation vehicles which routinely carry mentally and physically handicapped persons to alert motorists and rescue personnel to the fact that bus passengers may have mobility and other impairments and may need special assistance in evacuating the vehicle in an emergency situation. (Class II, Priority Action) (H-84-7)

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

When purchasing buses of the types designed to meet the Federal standards for schoolbuses built after April 1977, which are intended for special-purpose uses in which the standards are not mandatory, conduct an evaluation of any proposed modifications for their possible adverse effects on the safety of the intended passengers. (Class II, Priority Action) (H-84-8)

--to the New York State Department of Motor Vehicles:

Seek amendment of Section 375.29a of the New York State Vehicle and Traffic Law to require the use of safety chains, cables, or other redundant devices with any dolly that is used for transporting a vehicle on public highways that is incapable of being towed on its own wheels. (Class II, Priority Action) (H-84-9)

--to the New York State Association for Retarded Children:

Require all drivers to wear seatbelts while operating the Association's vehicles. (Class II, Priority Action) (H-84-10)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ G. H. PATRICK BURSLEY
Member

/s/ VERNON L. GROSE
Member

Member Grose, Concurring and Dissenting:

I respectfully dissent on the probable cause as stated. Rather than being singular as implied, it is a collection of five distinct and unranked causal elements, all of which I concur contributed to the accident and its severity. Further, since the establishment of probable causes (1) is not an end in itself but a means to the end of preventing future accidents of similar nature, (2) is intended to stimulate specific corrective actions to be taken, and (3) should, in this case, produce unique corrective actions correlated with the individual causal elements, it is misleading to imply a focused singularity rather than the true complexity of accident avoidance.

/s/ VERNON L. GROSE
Member

PATRICIA A. GOLDMAN, Vice Chairman, and DONALD D. ENGEN, Member, did not participate.

April 3, 1984.

APPENDICES

APPENDIX A

INVESTIGATION AND HEARING

Investigation

The National Transportation Safety Board was notified of this accident through the news media at 5:35 a.m. e.s.t. on April 6, 1983. Investigators were dispatched from the Washington, D.C. Headquarters on April 6, 1983. Investigators were assisted by the Chenango County Sheriff's Department, and representatives of the New York State Department of Transportation, Community Workshop (Chenango County Chapter of the New York Association of Retarded Children), and the American Transportation Corporation.

Deposition

There were no depositions taken or public hearings held in conjunction with this investigation.

APPENDIX B

NEW YORK STATE GROUP SPECIFICATION 40520 - BUSES
(Department of Transportation)

- TYPE V** - 40 adult passenger bus with 77" aisle headroom and the following additional specifications:
- Adapt a conventional style 25,000 G.V.W.R. school bus.
 - Eliminate all school bus markings.
 - 3-step stepwell
 - 10 rows of 2/2 transit type forward facing seats.
 - 365 C.I.D. engine
 - automatic 4-speed transmission, Allison AT40
 - With Option #1: 7 rows of 2/2 forward facing seats for 28 plus 4 wheel-chair stations.

OPTIONS: (For all Types)

1. Modify vehicle to provide: A wheelchair entrance with "Hold open" feature on doors; a wheelchair lift; and spaces for adult wheelchairs with manual, lever controlled wheelchair locks and lap belts installed. The lift shall be a 650 lb. capacity, electric/hydraulic type with a "pendant" control, and a manual override for lowering. The platform shall be not less than 32"x42" with provisions to contain the wheelchair. Portions of the lift extending into the interior shall be padded or guarded, to prevent a hazard to the passengers. Lift shall be mounted at the rear of the curbside, except for Type I which may be located as dictated by the body configuration. Wheelchair entrance door to be equipped with locking device.

The lift design shall also include: ramp on platform which automatically provides a minimum 4" high, positive wheelchair stop when platform is raised; manual hydraulic system for emergency operation of all lift functions, minimum 56" opening height; down-pressure cut off switch if platform not lowered by gravity.
2. Same as Option #1 but provide a minimum 650 lb. capacity foldable/stowable ramp in lieu of the lift. The ramp shall have a "non-skid" surface with minimum 2" high edges designed to contain a wheelchair. The rise/run ratio shall not exceed 1 in 3, and width minimum 29".
3. Manufacturers standard factory air-conditioning system: min. 20,000 BTU for Type I; 30,000 BTU rating for Types II & III; 50,000 BTU rating for Type IV; and 60,000 BTU for Type V.
4. "Snow" Tires on rear vs standard.
5. Non-spin differential, mfr's standard.
6. Addition/deletion for each wheelchair station with lock and lap belts.
7. Addition/deletion for each 2-passenger seat.
8. Heavy Duty, minimum 90 amp. alternator.

APPENDIX C

MEDICAL INFORMATION ON OTHER FATALITIES IN BUS

A 34-year-old woman, who occupied seat 2-A (see figure 7), sustained extensive pulmonary contusions and hemorrhage to the left lung and the lower lobe of the right lung, subendo cardiac hematoma left ventricle; mediastinal hemotoma, fractures to the first through fifth left ribs, severe subluxation of upper cervical vertebral column, and extensive contusions, abrasions, and echymosis of face and extremities.

A 55-year-old woman, who occupied seat 3-A, sustained massive injuries to the left side of the skull, extensive fractures, an avulsion of the brain, and a compound fracture of the left thigh and simple fractures of the arms and pelvis.

A 39-year-old woman, who occupied seat 3-B, sustained severe head injuries, a skull fracture with avulsion of the brain, fractures to the arms, and multiple contusions.

A 24-year-old woman, who occupied seat 4-B, sustained severe head injuries, multiple contusions to the left chest, a fracture and dislocation of the left scapula, and multiple lacerations to the left leg from ankle to thigh.