Increasing School Bus Safety for New York State's Children through Seat Belts on School Buses and the Elimination of Standees!

A Report to the Legislature by the New York State Legislative Commission on Critical Transportation Choices

Senator Norman J. Levy, Chairman

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This report has been prepared under the direction of the Commission members by the staff of the Legislative Commission on Critical Transportation Choices based on information received at public hearings, meetings with responsible officials, and staff research. The analyses of specific problems and the recommendations contained in this report do not necessarily reflect the individual views of all members of the Commission. A majority of Commission members, however, have approved the report as a whole and concur with its general thrust regarding the transportation needs of New York State.

The New York State Senate has been a national leader in efforts to improve school bus safety dating to 1962 when Senator Edward J. Speno introduced a bill--S.309--mandating the installation of seat belts in all vehicles transporting children to and from school. These efforts were continued in 1973 by Senator John D. Caemmerer who sponsored S. 839, requiring a seat belt for every passenger on a school bus. Beginning September 1, 1977, all vehicles in this state used for pupil transportation with a maximum seating capacity of twelve persons, were required to have safety belts.[1]

New York State, through the sponsorship of Senator Norman J. Levy and Assemblyman Vincent J. Graber, was the first state to enact a mandatory seat belt use law for passenger vehicles, effective December 1, 1984.[2] Subsequently, many parents, Parent-Teacher Associations, and other interested parties have been disturbed by the apparent inconsistency in public policy. Since April 1, 1982, adult drivers in New York State are required to place all children under four years of age in child restraint seats. They are also required to restrain

children under sixteen years of age via seat belts when they are seated in the front of an automobile, as well as children under the age of ten when they are seated in the rear of a motor vehicle. Children over the age of 16 and up to the age of 18 are mandated to wear seat belts in the front seat of a motor vehicle, and are legally responsible, therefore, under the law. Children, however, are not protected by seat belts in school buses.

Of the State's 731 school districts, 28 districts have installed belts on at least some of their buses and other districts are considering equipping their buses with seat belts. Whether seat belts should be required on school buses became a subject of an ever greater dialogue and discussion following the February 1985 publication of Transport Canada's report of school bus crash tests which concluded that the so-called compartmentalized 24-inch school bus seat on Type I school buses without seat belts offers better protection for children.[3] In preparing for the issuance of this report and recommendations, the Legislative Commission on Critical Transportation Choices (LCCTC) conducted extensive research on the effectiveness of seat belts on school buses and overall school bus safety in the United States and other nations. In response to the study conducted by Transport Canada, LCCTC along with the Senate Transportation Committee (STC) sponsored a comprehensive round table discussion to consider the Canadian School Bus Crash Tests in Albany, New York, on December 16, 1985, with invited experts from the United States and Canada giving testimony.[4]

THE TRANSPORT CANADA STUDY

In the Transport Canada tests, three types of buses - large (standard 66 passenger) , mid-size (intermediate 22 passenger) and van type (20 passenger campwagon van) - were subjected to thirty mile per hour front-end barrier crashes. Each bus carried six 5th percentile adult anthropometric dummies, three belted and three unrestrained.[5] The selection of the 5th percentile female dummies has been widely criticized because the size of the dummies purposely targets their heads to the area of seat backs where the padding narrowly covers the metal bars of the seat. Thus, use of the 5th percentile female dummy inherently results in excessive HIC readings in crash tests, thereby severely prejudicing these tests against seat belt use.[6] A major flaw in the Canadian study was the failure of Transport Canada to use dummies of various sizes to represent all sizes of children. The 5th percentile dummy represents approximately a five feet, two inch, one hundred pound twelve year old child, and was chosen as more apt to incur increased head injuries. However, in spite of these test induced disadvantages, the dummies wearing seat belts on the large bus were protected adequately from injury and death.

Experimentally, Head Injury Criteria (HIC) levels of greater than 1,000 and Chest Accelerations with a force of gravity greater than sixty generally are accepted by medical safety experts as sufficient to produce severe injury or death. [7]

In the crash of the sixty-six passenger bus, the only dummy experiencing life threatening forces was dummy number I seated unbelted in the front left hand seat which experienced a chest reading of 60.4g.[8] All belted dummies recorded impacts within acceptable safety limits. Although the bus met all current United States Federal standards including Standard Number 222 for school bus seat height and padding and for seat performance in crashes, it did not meet

New York State's standard for 28 inch seat backs--a critical safety omission. Transport Canada also concluded the use of lap belts in the mid-size bus and small van-type bus also may result in more severe head injuries for a twelve year old child, than for an unbelted twelve year old child. The results of the Canadian crash tests prompted LCCTC's study and this report.

THE STATISTICAL RECORD

School buses have a better safety record than passenger automobiles for three major reasons. (1) The advantage of weight protects buses in a traffic mix consisting chiefly of smaller vehicles since buses usually inflict more severe damage than they sustain. (2) School vehicles are less frequently on the highways during peak accident periods such as evening rush hours, at night , or on weekends and holidays. (3) School buses are conspicuous; motorists are conditioned to watch out for them and yield the right of way.[9] Because of the relatively good safety record of the operation, the National Highway Traffic Safety Administration (NHTSA) has not ranked school bus design improvements among its top priorities.

Approximately 26,000 school buses daily transport nearly two million children to and from their respective schools in New York State.[10] School districts operate 13,275 buses and private contractors operate the remaining 12,740 In addition, 364,000 students are transported by pub1ic transit services. Current estimates show that thirty-three percent of school buses in the United States are pre-1977 and over fifteen percent of New York State's total fleet is pre-1977.[11] These pre-1977 school buses do not meet United States Federal safety standards and as a consequence there is a marked increased probability of injury or death to children in a school bus collision.

Deaths and injuries of pupils resulting from school bus accidents remain at high levels in New York State. In the decade 1975-1985, there was an average of 844 accidents per year resulting in 5,670 pupil injuries and 18 pupil fatalities on and off the buses.[12] In the 1984-85 school year, school buses were involved in 466 accidents resulting in 239 pupil injuries and one fatality compared to the 1983-84 school year when school buses were involved in a total of 690 accidents, resulting in 348 injuries and seven fatalities.

In October 1985, a school bus accident in Mahopac, New York, resulted in a fatality of an 11 year old child who was a school bus passenger. That fatality has intensified efforts to mandate seat belts on school buses because New York State's current compartmentalization standards provide inadequate safety protection for children when a collision occurs.

Nationwide, school bus transportation accidents resulted in 100 deaths in 1984, including 45 pupils, 5 bus drivers, and 50 other persons.[13] Of the pupils killed, ten were passengers on school buses. Injuries in school bus-related accidents totaled about 8,400 and included 5,500 students.

Appendix Table I details the injury and property damage accidents which occurred in 1984 in all states. Types of school bus accidents not itemized are estimated to be more than 500, including railroad, pedestrian, and bicycle. Approximately eight of ten accidents involved

property damage without injuries. For details on school bus accidents per 100,000 student days in 1983-84, see Appendix Table II.

The danger of accidents involving school buses is always present as Senator Norman J. Levy stressed at a public hearing on school bus safety in Albany on November 14, 1983:

Even the most exemplary of busing operations can not anticipate the mistakes that other users of the road will make as well as their own mistakes. The most vigilant of bus drivers will be forced to deal with hazardous road conditions caused by weather and unexpected mechanical failures. It goes almost without saying that accidents can not be totally avoided.[14]

Progress in improving school bus safety has been made in recent years as safety advocates and legislators focused attention on needed improvements. New York State has been a leader in this field with requirements exceeding federal standards in many areas. Although school buses are one of the safest forms of transportation and though "the number of [school bus] fatalities and injuries is relatively small ... we must decide if relative safety is enough."[15] The central concern continues: will New York State or the federal government have to respond legislatively to a major tragedy because it settled for relative safety based on statistical records?

DATA ANALYSIS

School buses inherently are much less safe in terms of construction than intercity buses, city transit buses, and passenger cars.[16] In spite of improvements mandated by federal regulations in 1977, following the tragic loss of six lives in a school bus accident in Congers, New York, school buses nationwide are still not able to protect children in the event of an accident. The New York State Legislature acted to improve school bus safety prior to the promulgation of the federal regulations by requiring buses manufactured after December 31, 1975, to be equipped with 28-inch padded seats--which have been proven to provide whiplash protection superior to that provided by seats meeting the federal seat standard.[17] In 1977, New York State also exceeded federal standards by requiring roof hatches and additional emergency exits on school buses.

Federal regulations were promulgated by NHTSA in 1977 to implement the 1974 Motor Vehicle and School Bus Safety amendments to the National. Traffic and Motor Vehicle Safety Act of 1966.[18]

The following federal school bus safety standards became effective on April 1, 1977:
--Standard 217 specifies bus window strength and emergency exit requirements;
--Standard 220 establishes performance requirements for school bus rollover protection;
--Standard 221 establishes requirements for the strength of body panels and joints in school bus bodies; and
--Standard 222 establishes standards for seat height and padding and for seat performance in crashes.[19]
School bus safety advocates charged that these regulations are inadequate relative to passenger seating, crash protection, and emergency exits.[20]

Maintaining the State's excellent school bus safety record is a high priority item on the State legislative agenda. In a report, School Bus Safety in NewYork State . . . Children at Risk, LCCTC recommended all buses manufactured for use in New York State after July 1, 1986, be equipped with seat belts, back-up beepers, front crossing control arms, and twenty-eight inch padded seats on school passenger vans.[21]

THE DECEMBER 16, 1985 ROUND TABLE DISCUSSION

The round table discussion, initiated by the Legislative Commission on Critical Transportation Choices and the Senate Transportation Committee, is part of a continuing effort by Senator Norman J. Levy and Assemblyman Vincent J. Graber and other members of the Legislature to improve school bus safety and keep New York the leader in setting transportation safety standards. Testimony at the round table discussion on December 16, 1985, in Albany revealed the findings of the Canadian study raise more questions than answers about the safety value of seat belts on school buses. Proponents of seat belts on school buses concluded the Canadian tests are not relevant to New York State, a subject discussed in detail in a subsequent section.

Mr. William T. Gardner, Head of Crash Worthiness and Road Safety at Transport Canada, detailed the Canadian crash tests and opened his discussion by stating that:

…the Canadian government is committed to seat belts as a primary means of occupant protection in all vehicles. We have federal standards requiring the fitment of seat belts in automobiles. The provincial governments have-passed regulations such that ninety-five percent of the Canadian population is required to use seat belts . All provinces have passed child restraint regulations requiring use of child restraints.[22]

Gardner added:

In principle, we support the use of seat belts on school buses. However, we are responsible as government officials for providing information to legislators to assist them in making decisions, and that is the reason why these tests were conducted… the purpose of seatbelts is to retain an occupant in the vehicle in t h e event of a crash, and there is no question that seat belts will provide a valuable function in a rollover situation or any condition i n which the occupant may be thrown clear of the vehicle . However, the most common of type of accident was a frontal collision and it became clear that there could be a problem with impacting the seats in the vehicles and, for that reason, a number of standards were enacted .... [23]

According to Gardner, Transport Canada "chose this particular series of tests in order to replicate the most frequent kind of accident; that is a frontal accident. We used 5th percentile female dummies as the best representation of a large child. This would be a worst case situation."[24]

Gardner noted the head injury criteria employed in the tests may not be adequate for adults and application of these criteria to children creates a problem. The dummies were uncalibrated and the data produced by the tests have little comparative value. The tests, however, suggest that lap belts may contribute to head injury.[25]

Gardner concluded by reporting Transport Canada is studying five alternatives to lap belts on school buses. The five alternatives are (1) contoured, heavy thick padded seat backs, (2) 3 - point seatbelts, (3) redesigned seatbacks, (4) a forward facing multi-point restraint system tying the occupant to the seat, and (5) a rear facing multi-point restraint system. [26]

Proponents of seat belts in school buses argued the Canadian study is of limited value for several reasons , including use of unrepresentative dummies John D. States, M. D. Chairman and Professor, Department of Orthopaedics , University of Rochester and Chairman of the New York Coalition for Safety Belt Use, in a letter to Senator Norman Levy enumerated five limitations of the study:

1. Anthropomorphic dummies as specified in Part 572 of the United States Department of Transportation Federal Motor Vehicle Safety Standards were used. These dummies do not accurately model the flexibility of the human spine, and particularly the spine of a child. The stiffness of the dummy spine induces excess velocity in the head by the time the head contacted, the seat in front of a belted dummy. The additional stiffness also prevents contact, of the chest, shoulders, and upper extremities with the seat in front. This contact would share loading and reduce the head accelerations and the Head Injury Criterion (HIC). The Part 572 dummy was recognized in the FMVSS in 1972 and has not been upgraded in spite of the availability of much more representative dummies: i.e. the Hybrid 3 dummy.

2. Adult injury criteria were used. The HIC of 1000 is almost certainly not applicable to children. Experimental studies have demonstrated that arterial vessel walls in the brain of children are significantly more resistant to tearing than similar adult tissues. The skull's of children are more flexible and elastic and better able to tolerate impact trauma than the adults. No consensus exists concerning a child'[s] HIC but it is my personal impression that it is greater than 1500 and possibly 2000 rather than the 1000 used for adult.

3. Children are more resistant than adults to impact injury in all parts of their body. Experimental and accident investigation studies reveal that the bones of children have greater tensile strength and are more resistant to fractures, that ligaments, muscles, and blood vessels of the periphery have greater tensile strength. Field accident experience bears this out. Spinal cord injury is virtually unknown in children under age 14.

4. Seat backs used in New York State school buses are 28 inches high, 4 inches higher than the seat back required under Federal Motor Vehicle Safety Standard 222. The additional height ensures that the 5th Percentile dummies used in the Canadian tests will impact the vertical surface on the back of the seat rather than the top of the seat back as occurred in the Canadian tests. The top of the seat backs of the Thomas buses used in the test are particularly stiff because of the presence of a pipe placed crosswise in the seat.

5. The Canadian tests ignored the spectrum of accident configurations experienced by school buses in the real world. While completely reliable accident statistics do not exist for school buses because of the infrequency of school bus accidents, it is reasonable to conclude that

approximately half of injury producing school bus crashes are head on impacts, another third are rollovers and side impacts, and the remainder rear end impacts. Safety belts will give excellent protection to occupants in rollovers and side impact accidents. The belts will hold the occupant in place and prevent them from striking the roof or opposite side of the bus. In addition, safety belts will provide protection in head on impacts when pitch occurs.

In the real world, occupants are frequently pitched upward as well as forward and thrown from their seats. This happened in the recent fatal accident which occurred in Mahopac, New York on 10/15/85 when Paul Goodrow, Jr., was killed. This was an accident of minor impact severity and he was the only occupant to sustain significant injury, If he had been wearing a belt, he would have been held in place and not thrown out of his seat (emphasis added). [27]

Although Dr. States noted that children have a HIC level which greatly exceeds the current federal standard of 1,000, effort to overcome the slightest doubt of the Transport Canada study, Senator Norman J. Levy posed the question as to whether increased padding on seat backs and tops, coupled with safety belts would be effective. In a subsequent letter to Senator Norman Levy, Dr. States added: "Upgrading the performance of the seat back padding in the head contact area decreasing the Head Injury to 800 as a performance requirement in combination with lap belts will significantly improve the performance and provide additional protection."[28]

Jerome Palisi, a NHTSA Supervisory Highway Safety Management Specialist, stressed NHTSA's position that Federal Motor Vehicle Safety Standard Number 222, which requires compartmentalization, provides a high level of safety.[29] HTSA currently is studying the "carry-over" effect of children wearing seat belts in automobi1es .

UNIVERSITY OF MICHIGAN STUDY

Subsequent to the LCCTC public hearing, the Department of Mechanical Engineering and Applied Mechanics (the Department) of the University of Michigan issued a report critiquing the Transport Canada School Bus Safety Study.[30] The report noted that the Department does not agree with the interpretation of the results presented by the Transport Canada authors. The report addresses primarily the problems of head and neck injury prediction as related to the dummies used.

The reason for the higher values among the restrained dummies, according to the report, is quite clear and supports the need for occupant restraints on, buses. While the restrained dummy heads contacted the padded seat backs (which could have been better padded), the necks of unrestrained dummies hit the top of the seat backs where no load cells or accellerometers were mounted to measure the injury impact. The report also noted that shorter belted dummy, such as one representing a 6-year-old child, probably would have missed the seat back entirely while still being restrained safely in its seating position.

The Transport Canada study pointed out that the dummy neck is unrealistically stiff, but failed to recognize that the torso is rigid, according to the Department. This rigid torso transfers the entire upper-body bending motion to the only flexible unit the neck. The report added "humans bend differently than the stiff dummies used by Transport Canada and do not tend to suffer life threatening neck injuries in these situations." [31]

The University of Michigan report concluded that the Canadian School Bus Safety Study does not support the contention that the use of belts on recent-model large school buses poses a potential danger to the occupants in terms of increased likelihood of severe head and neck injuries in frontal crashes. The Department report concluded:

Although the best possible occupant restraint system would include a shoulder belt as well as a lap belt, which is the approach now being pursued by Transport Canada, this possibility is probably far in the future. In the absence of any definitive evidence to the contrary, we firmly believe that newly purchased large school buses should be equipped with lap belts to provide their occupants with protection similar to that available in the rear seats of automobiles. [32]

UNIVERSITY OF CALIFORNIA AT LOS ANGELES STUDY

Various reports, dating from 1967, have recommended installation of safety belts in school buses. A series of school bus collision experiments conducted by the University of California at Los Angeles (UCLA) in 1967 led the authors to the following conclusions:

Seat belts recommended for safety seats. These bus experiments, the many actual school bus accidents investigated by the authors, the many types of collision experiments conducted during the past 16 years by the authors and investigations by others, clearly establish the value in passenger protection of lap belts when used with high back seats. The greatest single contribution to school bus passenger collision safety is the high strength, high back safety seat. Next in importance is the use of a three-point belt, a lap belt or other form of effective restraint. These restraints can be added to the safety seat at very little added cost and their presence provides the continuity needed for proper training of youth concerning habitual use of restraints when riding in any vehicle.[33]

The UCLA study noted that lap-type safety belts would provide substantial additional protection to the school bus passengers seated in high back seats that have efficient padding on the rear panels of its backrests. The authors added that lap belts also provide hip restraint against sideward movement, thereby reducing forces that a displaced passenger may apply to a companion seated beside him during a side-impact collision.

EXPERIENCE WITH SEAT BELTS ON SCHOOL BUSES

Seat belts or seat belts with shoulder harnesses will restrain the forward movement of a child's body in the event of a frontal collision or rapid' deceleration.[34] Safety belts also will hold a child in his or her seat during the rebound effect of a rear-end collision or as a result, of the bus being struck on a side, turning over, rolling over, or going through other erratic maneuvers.

Appendix Table III reveals that 50.0 percent of the occupant fatalities in school buses occurred in rollover accidents and 14.7 percent of the occupant fatalities occurred in side impact accidents.[35] It is in these types of accidents that safety belts would provide additional safety for school bus occupants. For example, ejections, which could be prevented by use of belts, represented one-fourth of all fatalities. [36] However, a number of school bus accidents resulting in fatalities are so catastrophic that it is improbable that any type of occupant protection system would offer sufficient protection.

Between 1979 and 1983, three school districts in New York State--Greenburgh Central 7, Ardsley, and Comsewogue--became convinced of the value of seat belts and discovered that equipping new buses with safety belts is not difficult. The major school bus body companies offer safety belts in their new buses at a cost ranging from $18 to $30 per seating position.[37] The question of how many lap belts to install for a standard 39-inch seat depends on whether large or small children are being transported. The user makes this decision when ordering by specifying the number of belts per seat.[38] Consideration should be given to ordering belts with refractors as this feature encourages proper fit of the lap belt. Alternatively, providing bus monitors would assure correct belt positioning.[39]

There are approximately, seventy-eight school districts nation-wide with safety belt equipped large school buses.[40] Twenty-eight New York State school districts either have safety belts installed in their buses or have mandated belt installation within the next year. [41] Appendix Table IV contains information on the number of large buses in each fleet, use of monitors, type of belt installation, and buses on order in various school districts throughout the United States.

Two school districts in New York--Ardsley and Greenburgh Central 7--claim an eighty percent safety belt usage rate either with or without bus monitors, according to Carol Fast, Founder of the National Coalition for Seat Belts on School Buses.[42] Greenburgh's large buses have no monitors and Ardsley's eleven equipped buses have monitors. Nevertheless, each district reported similar high belt usage rates.

Training sessions for school bus drivers in the two districts helped them understand the importance of the safety belt program. The Greenburgh district commenced equipping its buses with belts in 1979 and was followed by the Ardsley district in 1983 . Greenburgh district drivers have written a pamphlet on school bus safety, including the use of belts on buses.[43] The drivers have become actively involved. In Ardsley, there are monitors on the kindergarten through eight runs. Both monitors and drivers have had special training sessions in teaching young children how to buckle up.

RETROFITTING

The National Coalition for Seat Belts on School Buses provides guidelines for those wishing to retrofit post 1977 built buses.[44] However, the Coalition does not recommend retrofitting pre-1977 manufactured buses because of various structural deterioration problems and inherent weaknesses in the seat frame. Furthermore, in a previous report the LCCTC recommended the State legislature enact a law phasing out of service older school buses.[45] Specifically, pre-1977

manufactured buses should be allowed to operate for a maximum of ten years through January 1, 1987, and post 1977 manufactured buses should be allowed to operate for a maximum of twelve years However, the New York State Department of Transportation (NYSDOT) should be authorized to grant extensions f or both pre- and post 1977 buses in good body and mechanical condition, on an individual basis, after inspection. Some school buses meeting the 1977 Federal safety standards have been retrofitted successfully in various school districts throughout the State, such as Greenburgh Central 7 and Ardsley. The Coalition suggests t h e following guide lines for seat belt installation in Large Type I school buses be followed before retrofitting:

In order to avoid an improper installation of your seat belts, we suggest that you follow these guidelines The belts measuring from where the seat cushion joins the seat back should have a short end of 16" and a long end of 29". The aisle positions must have the short 16" end to avoid a tripping hazard. The belts should be attached to the posterior seat frame under the seat cushion and not to the walls of the bus, or the leg of the seat. Each set of belts should be a different color and the buckles should be a light-weight plastic. Only one end of the belt should be adjustable, not both ends f or an even load distribution. Preferably the belt should buckle in the front center of the abdomen, not on the side. Similar buckle ends should be attached at the aisle positions so the belts can not be attached across the aisles.[46]

NHTSA recommends that school districts planning to retrofit post 1977 school buses should purchase only lap belts that meet Federal Motor Vehicle Safety Standard Number 209 pertaining to the installation and design of safety belts in automobiles and small buses.[47] NHTSA also recommends that competent engineering advice should be sought prior to retrofitting post 1977
manufactured buses.[48] School districts in New York are eligible for State reimbursement of up to ninety percent for costs incurred to retrofit school buses with safety belts.

IMPROVED PADDING

In addition to safety belts in school buses, the provision of improved padding on the back and top of seats would reduce the risk of serious head injury. The back and top of seats is the area where the potential for head impact is greatest in a front end collision.[49]

Enhancing the padding through additional thickness, or a more impact absorbing material also would decrease Head Injury Criteria (HIC) values. Such a decrease in HIC values would exceed by a substantial margin the minimum requirements of Federal Motor Vehicle Safety Standard 222 entitled "School Bus Seating and Crash Protection.11 The current Federal Standard for HIC is set at 1,000.

By decreasing Head Injury Criteria to 800, children riding school buses would be provided significantly better protection from head injury in the event of a collision. Even if children were thrown -forward, the improved padding would reduce the probability of serious head injury caused by impact with the seat back in front of them. Augmented padding or a change in material would also serve to reduce HIC levels for all school age children or other occupants over a wide range of crash severity.

PROPOSED SEAT BELT ON SCHOOL BUS LEGISLATION

Senator Norman J. Levy introduced a bill--S.1595C--in the 1985 New York State Senate amending the Vehicle and Traffic Law and the Education Law, effective July, 1987, to require school buses be equipped with seat safety belts and additional seat padding. Furthermore, the bill requires instruction on the proper use of seat belts for all passengers.

United States Representative Peter Kostmayer of Pennsylvania in January 1985 introduced a bill--H.R.749--amending title 23 of the United States Code to provide grants to encourage states to adopt and enforce laws requiring the use of safety belts by school children in new school buses and for other purposes. This bill authorizes $10,000,000 annually for the fiscal years ending September 30, 1986, 1987, 1988, to be appropriated out of the Highway Trust Fund other than the Mass Transit Account. A state would be eligible to receive the funds if it requires the use of seat belts on school buses and establishes a program to educate operators of school buses about seat belts.

In addition, bills relating to the installation and use of safety belts on school buses were introduced in twenty state legislatures in 1985.[50] In New York, the Suffolk County Legislature enacted Resolution No. 1008 of 1984 requiring all school buses acquired after January 1, 1986, to "contain safety restraints for each space capable of seating a passenger."[51]

However, three school districts have challenged the local law on Constitutional grounds and the county has repealed it.[52]

STANDEES ON SCHOOL BUSES

A related grave and fundamental issue of school bus safety is the practice of permitting school children to stand in the aisles of school buses while being transported to and from school. It is obvious that many of New York State's existing school bus safety features, such as compartmentalization, do not protect students who are forced to stand in the aisles.

Senate Bill 2123B, introduced in the New York State Senate by Senator Norman J. Levy in the 1985 session, would phase out standees over a three year period, beginning on September 1, 1987.

Present New York law permits, and even encourages, this practice. School districts are required to transport all students who live more than one and one half miles from their school and all handicapped children. If a district chooses to transport children who do not f it into either of these categories, the New York State Education Department (NYSED) does not provide transportation aid to the district for these children and districts must absorb the total cost. Therefore, in order to receive the maximum State aid available for each bus, some students will be transported without a seat.

The elimination of standees on school buses was the single most widely endorsed modification of existing law at the school bus safety hearings held by the LCCTC in 1983. Ronald Segedy, Assistant Commissioner for the New York State Department of Motor Vehicles (DMV), stated:

Allowing passengers to stand on buses removes those standees from the protective features of the bus and makes the standees unnecessarily susceptible to injury in the event of a rapid change in the speed of the bus and in the event of a collision not only are the standees themselves placed at risk of injury, but also seated school bus occupants who are in the path in which a standee's body may be thrown in the event of a crash.[53]

FINDINGS AND CONCLUS IONS

While considerable progress has been made in school bus safety in past years , more of vital importance remains to be done, and now, not in the future, to protect the children who ride in New York's school buses. Although the skill and sense of responsibility of the driver and the soundness of operational practices play a vital role in accident avoidance, the school bus must be
built in the future with more injury and life saving protection in mind and fact. Even an exemplary busing operation has to contend with the mistakes of other drivers, hazardous road conditions, or vehicle failure.[54] Accidents may be unavoidable, but the outcome need not lead to human tragedy. Although today's automobiles are built with occupant protection in mind, school buses have not been designed with the same degree of emphasis upon occupant protection.

In addition, the required use of seat belts in passenger automobiles in New York State and their acknowledged safety value make their absence in school buses even less justifiable and acceptable. Although it is important to recognize that belts alone do not provide adequate protection, the suggestion that belts in buses create a greater hazard than buses without belts has been conclusively rebutted as a result of the LCCTC hearing, extensive staff research, and the University of Michigan study. Another argument in support of seat belts on school buses is children are required to use belts in the family automobile and consequently are more apt to want to buckle up in the school bus, and when they can not, are put into a state of anxiety when riding unbelted.

The New York State School Board Association, school transporter associations, many school bus manufacturers and local school boards are opposed to seat belts on school buses allegedly because of increased costs. This spurious argument is not borne out by the facts. The cost range for belts varies from $1,100 to $1,500 for a sixty-six passenger bus and adding additional padding to seat backs and tops will cost an estimated additional $300 per bus. However, if seat belts are mandated statewide, the cost of belts would decrease as a result of increased competition among school bus manufacturers. School districts receive up to 90 percent reimbursement in State education aid for state transportation costs which means that, for a school district, the cost for seat belts and improved padding will range from $140 to $180 per bus, a small price for the obvious safety enhancement.

Another concern which has been raised over the years is that seat belts are used by children as "weapons." However, concern is unfounded based on both the practical experience of school districts already using belts and by the expert testimony provided by school bus safety advocates such as the New York State PTA, Physicians for Automotive Safety, National Coalition for Seat Belts on School Buses, New York Coalition f or Safety Belt Use, and the American Pediatrics Association.

Many of the arguments raised against the use of seat belts are similar to those originally raised in opposition to other safety features such as the twenty-eight inch padded seats. At least one of the groups, the New York State Association for Pupil Transportation, originally opposed the twenty-eight inch seat backs and later changed its position based upon the safety record and practical experience since the use of this safety measure was mandated.[55]

RECOMMENDATIONS

Providing safety belts in school buses will save lives and prevent or reduce the severity of injuries.[56] Requiring extra padding on seat backs combined with lap belts will reduce further HIC levels and facial lacerations in school bus accidents.[57]

Seat belt use on school buses will have a positive carry-over affect on school children when they are being transported in passenger vehicles.

1. Safety- belts should be standard equipment on every school. bus manufactured on and after July 1, 1987, for use in this State.

2. Improved padding on seat backs and metal cross bars should be required on all school buses equipped with seat belts, with such improved padding exceeding current federal standards by twenty percent.

3. Standees on school buses should be phased out over a three year period beginning with the 1987-88 school year.

4. Pre-1977 school buses should have a useful life which does not exceed ten years unless an exemption is granted by the Commissioner of Transportation.

5. Post 1977 school buses should have a useful life which does not exceed twelve years, unless an exemption is granted by the Commissioner of Transportation.

6. Post 1977 school buses should be retrofitted with seat belts and additional padding on a case by case basis. The Commissioner of Transportation should promulgate rules and regulations necessary to effectuate such retrofitting and have the power to prohibit certain designed school buses from retrofitting.

7. Retrofitting should be 100 per cent state aidable.

8. Pre-1977 school buses should not be retrofitted with seat belts.

9. The Commissioner of Motor Vehicles should develop a course of instruction on the safe use of seat belts for grades K-12.

10. School bus operators should receive training on the proper use of seat belts by all school bus passengers.

11. All seat belts should be color coded to eliminate confusion amongst passengers.

12. The Congress should enact Federal legislation which would require the installation of seat belts on new school buses, nationwide.

Including additional padding on the backs of school bus seats in conjunction with lap belts and New York State's present 28-inch seat will ensure children a safer ride to and from school. Logic indicates that there will be less impact to the head during a front end collision if there is more padding on the seat back. However, LCCTC recommends additional research by Transport Canada, NHTSA, and other similar safety organizations relative to the following alternatives to lap belts which may possibly provide even more protection to children riding school buses in the future. Additional research should not be, and is not, a justification for not acting now to require seat belts on school buses.

ALTERNATIVES TO LAP BELTS
1. Three point seat belts.
2. Contoured heavy thick padded seats.
3. Redesigned seat backs employing no metal crossbars.
4. A forward facing multi-point restraint system.
5. A rear facing multi-point restraint system.
6. Harnesses anchoring to the seat in four places--two at the shoulder and two at the lower back level.
7. An upper torso built system similar to ones used on aircraft.

APPENDIX TABLE I - SCHOOL BUS ACCIDENTS BY STATE - 1983 – 1984

				Type of School Bus Accident				Prop. Damage Only Acc.	Persons Injured	
State	**Vehicles**	**Annual Bus Mileage (000's)**	**Pupils Transprt Daily**	**Total[a]**	**Other Veh.**	**Non-Coll.**	**Fixed Obj.**		**Total**	**Pupils**
U.S.[b]	340,000	3,400,000	22,100,000	29,000	25,000	400	2,000	23,000	8,400	5,600
Alabama	…	51,105	386,239	258	242	2	14	245	104	97
Alaska	600	7,200	39,000	124	107	0	14	113	…	…
Arizona	3,316	35,245	199,986	199	184	2	6	135	143	72
Arkansas	4,180	39,428	263,916	230	80	2	0	203	68	57
California	17,248	245,555	867,549	1,282	897	65	69	976	536	286
Colorado				207	186	1				
Connecticut	4,686		243,000	788	684	0	39	683	136	37
Delaware	1,252	15,632	81,043	91	77	0	8	71	16	7
Dist of Col	144	2,073	2,600	58					7	6
Florida	7,787		738,007	579	386	0	110	531	48	24
Georgia	9,473		803,390	969			104		275	230
Hawaii	735	7,374	38,048	36	23	0	3	26	19	10
Idaho	2,004	18,989	120,000	99	77	1	8	81	18	12
Illinois	15,791	180,000	894,748	2,485	2,358	25	48	2,052	761	275
Indiana	8,629	59,529	663,834					673		128
Iowa	6,647	62,829	253,031	511	359	15	118	451	111	41
Kansas										
Kentucky	7,297	71,548	462,204	941	763	2	78	804	216	148
Louisiana	7,511	65,837	583,959	711	672	5	7	676	86	77
Maine	2,280	26,680	167,004	148	132	1	11	134	13	3
Maryland	4,880	71,940	444,222	1,032	915	4	97		45	21
Mass.	7,279	66,613	512,259	1,020	847	1	74	893	175	143
Michigan										
Minnesota	9,923	90,170	700,000	675	564	9	17	496	340	185
Mississippi	5,300	42,807	358,388	271					89	72
Missouri	9,242	96,279	453,662	599	527	0	32	501	259	193
Montana	1,320	17,827	63,108	55	48	3	3	51	4	4
Nebraska	3,622	31,139	61,427	153	145	0	6	132	29	14
Nevada	874	11,278	55,174	62	54	0	3	41	21	15
New Hamp.	1,827	10,793	94,482	190	165	2	16	160	83	59
New Jersey	12,600	120,000	628,412	573	446	22	59	273	298	206
New Mexico	2,021	23,330	130,691	161	137	1	12	136	35	14
New York			1,977,000	621	545	9	25	462	257	181
N. Carolina	12,825	110,511	725,732	1,246	1,018	5	9	887	697	613
N. Dakota	1,891	25,484	48,281	39	35	1	0		12	7
Ohio	14,374	153,207	1,319,505	1,665				1,437	225	225
Oklahoma	6,395	58,609	295,694	377	300	6	38	165	261	212
Oregon	3,822	39,611	226,650	330	240	9	73	304	44	13
Pennsylv.	19,521	230,112	1,545,995	2,011	1,700	58	214		406	142
Rhode Isl.	1,652	15,179	103,192	107	105	0	2	93	15	13
S. Carolina	5,942	59,857	438,117	834	779	12	22	807	422	387
S Dakota										
Tennessee	6,364	68,703	569,900	657	582	7	61	561	129	113
Texas	22,481		947,110	1,210	1,071	0	15	889		316
Utah										
Vermont										
Virginia	9,042	79,500	720,984	699	636	8	41	591	286	119
Washington	6,005	61,043	376,727	248	225	2	13	173	142	50
W. Virginia	2,941	37,338	292,061	690	524	0	165	674	56	29
Wisconsin	6,859	73,807	462,347	642	532	3	0	490	252	
Wyoming	1,289	13,074	41,322	52	45	2	3	47	8	3

Source: National Safety council survey of state departments of education and state traffic authorities. Most reports cover 1983-1984 school year or 1984 calendar year. U.S. totals are Councils estimates for the calendar year 1984.

a. Totals include additional accident types not shown separately.

b. Procedures for estimating U.S. totals have been revised for this addition and are not comparable to estimates in previous editions.

Source: Accident Facts (Chicago: National Safety Council, 1985), p.91

APPENDIX TABLE II - SCHOOL BUS ACCIDENTS BY TYPE OF TRIP - 1983 - 1984

Location and Type	TOTAL	Kgn	1-3 Gr.	4-6 Gr.	7-9 Gr.	10-12 Gr.	Days Lost per Inj.
Enrollment Reported (000)	880	56	210	199	218	178	
Total School Jurisdiction	5.72	4.67	3.57	6.54	7.55	5.51	1.51
Shops and labs	0.25	0.00		0.03	0.47	0.59	1.13
Homemaking	0.02	0.00	0.00	0.01	0.03	0.03	1.38
Science	0.02	0.00	0.00	0.00	0.04	0.05	1.04
Vocational, Ind Arts	0.19	0.00	0.00	0.01	0.35	0.43	1.17
Other labs	0.02	0.00		0.01	0.03	0.03	0.97
Other shops	0.01	0.00	0.00		0.02	0.04	1.03
Building - General	1.43	1.67	1.05	1.49	1.97	1.11	1.40
Auditoriums and classrooms	0.49	0.91	0.45	0.61	0.52	0.27	1.36
Lunchrooms	0.08	0.12	0.05	0.10	0.10	0.06	1.51
Corridors	0.27	0.22	0.19	0.22	0.46	0.22	1.18
Lockers (room and corridor)	0.05	0.00	0.01	0.03	0.10	0.09	0.83
Stair and stairways (inside)	0.22	0.04	0.08	0.18	0.41	0.24	1.75
Toilets and washrooms	0.07	0.16	0.09	0.09	0.04	0.02	0.96
Grounds – unorganized activities	0.93	1.23	1.30	1.98	0.31	0.08	1.42
Apparatus	0.19	0.58	0.36	0.31	0.02		1.36
Ball playing	0.16	0.02	0.08	0.43	0.12	0.03	1.14
Running	0.21	0.18	0.31	0.44	0.05	0.01	2.02
Grounds - misc	0.40	0.62	0.36	0.65	0.35	0.19	1.60
Fences and walls	0.02	0.06	0.02	0.05	0.01	0.01	0.72
Steps and walks (outside)	0.12	0.16	0.10	0.17	0.13	0.06	1.48
Physical Education	1.96	0.69	0.52	1.93	3.48	2.17	1.31
Apparatus	0.13	0.26	0.11	0.14	0.16	0.09	1.46
Class games	0.17	0.16	0.12	0.30	0.16	0.14	1.08
Baseball – hardball	0.02	0.00	0.00	0.01	0.05	0.04	1.19
Baseball – softball	0.06	0.02	0.01	0.07	0.13	0.06	1.39
Football – regular	0.04	0.00		0.02	0.08	0.05	2.70
Football – touch	0.10	0.00	0.00	0.04	0.20	0.20	0.87
Basketball	0.33	0.00	0.01	0.15	0.74	0.52	1.06
Hockey	0.02	0.00	0.00	0.03	0.04	0.03	1.89
Soccer	0.10	0.00	0.02	0.15	0.17	0.09	1.33
Track and field events	0.09	0.08	0.04	0.11	0.16	0.03	1.53
Volleyball and similar games	0.15	0.00	0.01	0.09	0.25	0.32	0.95
Other organized games	0.17	0.06	0.04	0.22	0.31	0.09	1.07
Swimming	0.04	0.00	0.00	0.01	0.10	0.03	0.81
Showers and dressing rooms	0.05	0.00	0.00	0.02	0.13	0.04	1.29
Intramural sports	0.07	0.00	0.00	0.01	0.14	0.13	2.85
Football – regular	0.02	0.00	0.00		0.04	0.06	1.31
Basketball	0.01	0.00	0.00		0.03	0.02	1.00
Interscholastic sports	0.27	0.00	0.00		0.41	0.81	1.91
Football – regular	0.11	0.00	0.00	0.00	0.15	0.34	1.50
Basketball	0.05	0.00	0.00		0.06	0.15	0.90
Track and field events	0.02	0.00	0.00	0.00	0.04	0.05	1.52
Special activities	0.07	0.02	0.02	0.10	0.08	0.08	1.60
Trips or excursions	0.03	0.02	0.02	0.07	0.02	0.02	1.28
Going to and from school (MV)	0.23	0.22	0.20	0.22	0.21	0.30	2.26
School bus	0.11	0.08	0.11	0.12	0.13	0.07	1.15
Other motor veh. - pedestrian	0.06	0.12	0.07	0.08	0.05	0.02	3.73
Other motor veh. – other type	0.05	0.02	0.01	0.01	0.01	0.21	1.31
Going to and from school (not MV)	0.11	0.22	0.12	0.13	0.13	0.05	3.59
Bicycle – not motor veh.	0.01	0.00		0.03	0.01	0.01	1.81
Other street and sidewalk	0.06	0.12	0.08	0.06	0.07	0.01	6.79

Source: Reporters to the National Safety council
Accidents are those causing the loss of one-half day or more of (1) school time or (2) activity during non-school time, and/or any property damage as a result of a school jurisdictional accident.
Some totals include data not shown separately Adjusted for half-day Less than 0.005

Source: Accident Facts (Chicago: National Safety Council, 1985), p.92

APPENDIX TABLE III
OCCUPANT FATALITIES BY PRINCIPAL DIRECTION OF IMPACT AND ROLLOVER
UNITED STATES 1981-1983 (In Percent)

PASSENGER VEHICLE				LARGE SCHOOL BUS (PASSENGERS ONLY)		
PRINCIPAL IMPACT DIRECTION	NO ROLLOVER	ROLLOVER	TOTAL	NO ROLLOVER	ROLLOVER	TOTAL
FRONT	41.5	6.8	48.3	20.6	35.3	55.9
SIDE	25.3	3.2	28.5	14.7	0	14.7
REAR	2.7	0.6	3.3	0	0	0
UNDERCARRIAGE	0.3	0.4	0.7	2.9	0	2.9
NON-COLLISION						
ROLLOVER	-	7.0	7.0	-	14.7	14.7
NO ROLLOVER	1.0	-	1.0	11.8	-	11.8
OTHER, UNKNOWN	5.3	5.9	11.2	0	0	0
	76.1	23.9	100	50.0	50.0	100
NUMBER OF AVERGAGE ANNUAL EJECTIONS			5557			3

Source: National Highway Traffic Safety Administration. Safety Belts in School Buses (Washington, D.C.: United States Department of Transportation, June 1985) p.8

APPENDIX TABLE IV
SAMPLE OF SCHOOL DISTRICTS WITH BELTS IN BUSES - APRIL 1985

SCHOOL DISTRICT	NUMBER OF LARGE BUSES WITH BELTS	MONITORS USED	RETROFITTED OR FACTORY INSTALLED	ON ORDER
Ardsley, New York	10	Yes	Retrofitted	N/A
Catalian Foothills, Arizona	5	No	Retrofitted	N/A
Comsewogue, New York	26	N/A	Factory installed	N/A
Dalton, Georgia	7	Yes	Factory installed	N/A
Glencoe District #35, Illinois	5	Yes	Factory installed	N/A
Greenburgh, New York	55	No	Factory installed	N/A
Hartland, Vermont	3	No	Factory installed	N/A
Klamath Falls, Oregon	3	N/A	Factory installed	N/A
Manchester, Massachusetts	5	N/A	N/A	N/A
Marblehead, Massachusetts	5	N/A	N/A	N/A
Middlebury, Vermont	1	No	Factory installed	N/A
Montgomery County, Maryland	0	N/A	Factory installed	53
Oxford, Mississippi	1	No	N/A	N/A
Peacham, Vermont	1	N/A	Retrofitted	N/A
Rochester, Michigan	0	N/A	Factory installed	4
Shelburne, Vermont	0	N/A	N/A	2+
Skokie District #68, Illinois	11	No	Retrofitted	N/A
Skokie District #72, Illinois	4	N/A	Factory installed	N/A
Waitsfield, Vermont	1	No	Factory installed	N/A
Weathersfield, Vermont	1	N/A	Factory installed	N/A
Wentzville, Missouri	0	N/A	N/A	7
West Orange, New Jersey	9	N/A	Factory installed	N/A
West Windsor, New Jersey	3	No	Factory installed	N/A
Wilmette District, Illinois	4	No	Retrofitted	N/A
Williston, Vermont	0	N/A	N/A	2+
Worcester, Vermont	1	No	Factory installed	N/A

N/A=Information not available

Source: National Highway Traffic Safety Administration, Safety Belts in School Buses (Washington, D.C.: United States Department of Transportation, 1985), p.14.

APPENDIX A
HEAD INJURY CRITERIA

S5.3 Impact zone requirements.
S5.3.1 Head protection zone. Any contactable surface of the vehicle within any zone specified in S5.3.1.1 shall meet the requirements of S5.3.1.2 and S5.3.1.3. However, a surface area that has been contacted pursuant to an impact test need not meet further requirements contained in S5.3.

S5.3.1.1 The head protection zones in each vehicle are the spaces in front of each school bus passenger seat which are not occupied by bus side-wall, window, or door structure and which, in relation to that seat and its seating reference point, are enclosed by the following planes.

(a) Horizontal planes 12 inches and 40 inches above the seating reference point;
(b) A vertical longitudinal plane tangent to the inboard (aisle side) edge of the seat;
(c) A vertical longitudinal plane 3.25 inches inboard of the outboard edge of the seat, and
(d) Vertical transverse planes through and 30 inches forward of the reference Point.

S5.3.1.2 *Head form impact requirement*. When any contactable surface of the vehicle within the zones specified in S5.3.1.1 is impacted from any direction at 27 feet per second by the head form described in S6.6, the axial acceleration at the center of gravity of the head form shall be such that the expression shall not exceed 1,000 where a is the axial acceleration expressed as a multiple of g (the acceleration due to gravity), and t, and t, are any two points in time during the impact.

S5.3.1.3 *Head form force distribution*. When any contactable surface of the vehicle within the zones specified in S5.3.1.1 is impacted from any direction at 22 feet per second by the head form described in S6.5, the energy necessary to deflect the impacted material shall be not less than 40 inch-pounds before the force level on the head form exceeds 150 pounds. When any contactable surface within such zones is impacted by the head form from any direction at 5 feet per second, the contact area on the head form surface shall be not less than 3 square inches.

S6.6 *Head form*. The head form for the measurement of acceleration is a rigid surface comprised of two hemispherical shapes, with total equivalent weight of 11.5 pounds. The first of the two hemispherical shapes has a diameter of 6.5 inches. The second of the two hemispherical shapes has a 2 inch diameter and is centered as shown in Figure 3 to protrude from the outer surface of the first hemispherical shape. The surface roughness of the hemispherical shapes does not exceed 63 micro-inches. root mean square.

S6.6.1 The direction of travel of the head form is coincidental with the straight line connecting the center-points of the two spherical outer surfaces which constitute the head form shape.

Se.6.2 The head form is instrumented with an acceleration sensitive device whose output is recorded in a data channel that conforms to the requirements for a 1,000 Hz channel class as specified in SAE Recommended Practice J211a. December 1971. The head form exhibits no resonant frequency below three times the frequency of the channel class. The axis of the

acceleration sensing device coincides with the straight line connecting the centerpoints of the two hemispherical outer surfaces which constitute the head form shape.

S6.6.3 The head form is guided by a stroking device so that the direction of travel of the head form is not affected by impact with the surface being tested at the levels called for in the standard.

Source: 49 CFR § 571.222 (1985).

APPENDIX B

LETTERS IN SUPPORT OF IMPROVED PADDING ON SEAT BACKS AND TOPS COMBINED WITH SEAT BELTS ON SCHOOL BUSES

PHYSICIANS FOR AUTOMOTIVE SAFETY
56 UNION AVENUE, IRVINGTON, NEW JERSEY 07111

Arthur Yeager, D.D.S.,
Chairman, School Bus Safety Committee
1 Park Place, Westwood, NJ 07675

March 7, 1986

Senator Norman Levy
Legislative Committee on Critical Transportation choices
17 Elk Stree
Albany, New York 12207

Dear Senator Levy:

I am pleased to endorse your proposal to require seat belts and more efficient padding, on all newly manufactured school buses purchased in the State of New York. When fully implemented this measure will substantially upgrade the level of safety for the two million children who ride New York school buses every school day.

Although those opposed to these improvements argue that youngsters are sufficiently "compartmentalized" between the school bus seats, the fatality in Mahopac and the bus roll over in Nassau County this week clearly indicate the need for seat belts to keep the children in the "compartment" as well as the need to make the "compartment" less hostile by enhancing the padding on the seat back.

With the passage of this legislation, New York will have the best school buses in the nation and New York's children will have the safest ride.

Sincerely,
Arthur Yeager

NEW YORK STATE CONGRESS OF PARENTS AND TEACHERS INC.
(Branch of the National congress of parents and Teachers)
119 Washington Avenue, Albany NY 12210

March 6, 1986
11 orlando Avenue
Ardsley, New York 10502

Dear Senator Levy

On behalf of the NY State PTA I am pleased that you have decided to include additional padding on the backs of school bus seats in bill #1595. This feature, in conjunction with lap belts and our present 28" seat, will ensure children a safer ride to and from school.

In light of the December 16, 1985 hearing in Albany on the Canadian Crash Tests, the PTA feels there is no need to worry about the possible head injury that opponents of belts on buses contend might occur in an accident where lap belts are in use. On the other hand, if there are those who are still concerned, then adding more padding should certainly allay their fears. Logic indicates that there will be less impact to the head during a front-end collision if there is more padding on the seat ahead.

The NY State PTA hopes your bill will pass, thus making New York a trend setter for other states. The National Highway Traffic Safety Administration only set minimum standards. Your bill for lap belts and extra padding on the back of each seat will substantially upgrade the 222 Federal Seat Standard.

Thank you for your continued support for safer school bus transportation.

Carol Fast
School Bus Safety Resource

National Coalition for Seatbelts on School Buses
March 7, 1986
11 Orlando Avenue
Ardsley, New York 10502

Senator Norman Levy
Chairman, Senate Transportation Committee
Room 811 Legislative Office Building
Albany, New York 12247

Dear Senator Levy,

As President of the National Coalition for Seatbelts on School Buses, I would like to congratulate you for including extra padding on the backs of school bus seats in your bill for lap belts on new school buses. Your bill will once again serve as a model for those states that wish to upgrade the NFTSA seat standards.

New York's 28" high back seats have already increased safety for children 13 years and older.

Thank you for the concern you have always shown for the safe transportation of school children.

Sincerely,
Laura Schwartz, President

APPENDIX C

THE DEPARTMENT OF MECHANICAL ENGINEERING AND APPLIED MECHANICS OF THE UNIVERSITY OF MICHIGAN REPORT ON THE TRANSPORT CANADA SCHOOL BUS SAFETY STUDY

THE UNIVERSITY OF MICHIGAN COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING AND APPLIED MECHANICS
ANN ARBOR. MICHIGAN 48109-2121

DATE: January 23, 1986

TO: Colleagues concerned about Child Passenger Safety

FROM:
Kathleen Weber, MA
John W. Melvin, PhD
The University of Michigan
Department of Mechanical Engineering & Applied Mechanics

RE: Transport Canada School Bus Safety Study

The School Bus Safety Study, conducted by Transport Canada in 1994 and reported to the public in January 1983, is being used by opponents of belts on school buses to "prove" that such belts would be dangerous for school bus occupants. We do not agree with the interpretation of the results presented by the authors nor with the secondary interpretations that are being widely communicated to the public. We believe that our collective experience of over twenty years in the occupant protection field makes us qualified to offer our opinions on the topic.

Although there are many questions related to the motivation for the study, the test procedures, the dummies, the significance of the measurements taken, and the validity of the judgements made, we will address primarily the problems of head and neck-injury prediction as related to the dummies used. Our discussion will also be limited to the test and results of the large school bus crash.

By way of background, a single crash test using a large Blue Bird school bus was conducted. The bus was occupied by six 5th-percentile female dummies which approximate the size and weight of a 14-year-old child, and two 6-year-old size dummies. Half the 5th-porcentiles were restrained by lap belts and half were unrestrained, but both 6-year-olds were unrestrained. Various seat spacings were used. According to a spokesperson for the Road and Motor Vehicle Safety Branch of Transport Canada, the selection of the larger dummy as the primary test device was due to the fact that teenagers were receiving the majority of the injuries in Canadian school bus crashes. The reason given for not including restrained 6-year-olds in the test was that more dummies were not available. Thus we have a situation in which it was known that unrestrained teenagers were already being injured in school buses, and an effort was being

made to improve that situation. It is therefore curious that a conclusion, from the study that "the passive occupant protection of the seating system . . . functions as intended during frontal impacts and provides excellent protection for occupants" could be taken as closing the issue. Clearly the conclusion, if valid, is very limited in its real-world application. It is also unfortunate that one of the 6-year-old dummies was not restrained f or comparison purposes, and it should be noted
that the bus itself suffered some serious structural failures that affected the test results.

HEAD INJURY. The injury measure used is called the Head Injury Criterion (HIC), and the report correctly states that there is some question "as to whether or not a HIC value of 1000 is a conclusive measure of serious head injury, particularly for children." Although the belted dummies did measure higher HIC values than the unbelted dummies, the highest HIC value was only 731, which is well below the 1000 limit and in the range found with the very best child restraint systems tested at the same impact speed. The reason for the higher values among the restrained dummies is also quite clear and supports the need for occupant restraints on buses. While the restrained dummy heads contacted the padded seatbacks (which , as the report indicates, could have been better padded) , the unrestrained dummies hit the top of the seatbacks with their necks instead, where no load cells or accelerometers were mounted. It is interesting that one of the unrestrained dummies "rolled inboard and fell in the aisle, striking its head on the instrumentation box mounted on the floor." Although this event was partially the result of a wider than normal seat spacing (27 in.) in this seating position, an oblique, lateral, or rollover crash could have the same effect . This type of uncontrolled occupant motion cannot be tolerated in any public school transportation system. It should also be noted that a shorter belted dummy , such as one representing a 6-year-old child , would probably have missed the seatback entirely with this as well as the narrower seat spacings, while still being safely retained in its seating position .

NECK INJURY. Because of the different interactions with the seatbacks between the restrained and unrestrained dummies, the neck was affected in different ways. As noted above, the unrestrained dummy necks interacted directly with the tops of the seatbacks, but the dummies were not equipped to measure the resulting loads and thus no reliable injury prediction can be made. When the restrained dummy heads hit the seatbacks, the heads rotated rearward causing neck extension (rearward bending) of varying amounts. The dummy in the seat with wide spacing (27 in.) experienced slight bending of the neck. The neck of the dummy in a seat having spacing allowed by the U.S. standard (24 in.) bent approximately 75 degrees. Finally, the neck of the dummy in the front seat, which was initially 21 inches from a forward restraining barrier and was pushed several inches closer due to bus structural failure, bent rearward approximately 90 degrees. The report claims in its summary that "The neck extension of-several restrained dummies was judged to be life threatening." Nowhere in the report, however, is there any discussion of or reference to the biomechanical justification for this judgement. Furthermore, the analysis section, in referring incorrectly to "neck flexure" and "flexion" (forward bending), states "There is, however, no criteria available to judge the possible severity of injury that could result from this bending." The report points out that the dummy neck is unrealistically stiff but fails to also recognize that the torso is rigid. This has the effect of transferring the entire upper-body bending motion to the only flexible unit, the neck. The rearward bending of the head observed in these tests is also routinely observed in

interactions of dummies with HPR windshields and certain airbag designs. We know from field experience that humans bend differently than these stiff dummies and do not tend to suffer "life threatening" neck injuries in these situations Finally, the biomechanical research of H.J. Mertz and L.M. Patrick indicates that the human neck can withstand neck extension of at lease 80 degrees without injury.

CONCLUSION. We do not believe that the Canadian School Bus Safety Study can be used to draw the conclusion that the use of belts on recent-model large school buses poses a potential danger to the occupants. No case can be made from the results of this test program that belted children will have an increased likelihood of severe head and neck injuries in frontal crashes. Although the best possible occupant restraint system would include a shoulder belt as well as a lap belt, which is the approach now being pursued by Transport Canada, this possibility is probably far in the future. In the absence of any definitive evidence to the contrary, we firmly believe that newly purchased large school buses should be equipped with lap belts to provide their occupants with protection similar to that available in the rear seats of automobiles.

APPENDIX D

VITAE

John D. States, M.D.

Graduated from the University of Rochester in 1946 and Harvard Medical School in 1949. Post Graduate training was done at Rochester General Hospital. Orthopeadics Training was done at Children's Hospital, Massachusetts and Massachusetts General Hospital.
Captain in the Air Force from 1951 to 1953 .

Began researching automobile accidents in 1959. Funding from NHTSA for automobile accident -research began in 1969. University of Rochester - chosen as one of first five Multidisciplinary Accident Investigation Teams – Principal Investigator.

Worked with the New York State Department of Motor Vehicles researching automobile accidents from 1973 to 1979.
Consultant to General Motors from 1976 to 1980.
Consultant on accident investigation in bio-mechanics for Volkswagon from 1976 to present.
Past member of the National Motor Vehicle Safety Advisory Council from 1969 to 1976.
Chairman of the New York Coalition for Safety Belt Use from 1982 to present.
Chairman of the Research Accident Investigation Unit at the University of Rochester from 1969
to present.
Chief of Orthopaedics at Rochester General Hospital from 1969 to present
Professor of Orthopaedics at the University of Rochester from 1976 to present.

Kathleen Weber, M.A.

Masters Library Science, University of Wisconsin.
16 years automotive safety, University of Michigan 10 years in charge of Research Library Automotive Safety 6 years research in occupant protection and child restraints.

Dr. John W. Melvin, Ph.D.

Ph.D. Theoretical and applied mechanics University of Illinois Research human impact tolerance and occupant protection
Senior Research Associate, University of Michigan
Associate Professor, University of Michigan.

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[1] 17 NYCRR § 49.6 (a) (1984).
[2] New York Laws of 1985, Chap. 365 and New York Vehicle and Traffic Law, § 1229-c (1985 supp.).
[3] School Bus Collision Tests (Ottawa: Transport Canada, 1985)
[4] Transcript of "Round Table Discussion to consider the Canadian School Bus Crash Tests sponsored by the New York State Senate Committee on Transportation and the Legislative Commission on Critical Transportation Choices, Albany, New York, December 16, 1985." (Hereinafter cited as Round Table Discussion).

[5] A 5th percentile dummy is an anthropomorphic test device complying with National Highway Traffic Safety Administration's regulation 49 C.F.R. § 572 (1985).
[6] Letter dated December 23, 1985 to Chairman Norman J. Levy of the Legislative Commission on Critical Transportation Choices from John D. States, M.D., Chairman and Professor, Department of Orthopaedics, University of Rochester and Chairman of the New York Coalition for Safety Belt Use, Incorporated and Arthur Yeager, The Canadian Tests - (New York: National Coalition for Seat Belts on School Buses, 1985), p. 2.
[7] The Commission has adopted the National Highway Traffic Safety Administration definition of
Head Injury Criterion (HIC) contained in Federal Motor Vehicle Safety Standard Number 222. For the official Federal definition, see Appendix A.
[8] The Canadian_Tests, p. 2.
[9] School Bus Safety: Do Parents Have Reason to be Concerned (New York: Physicians for automotive Safety, 1980) , p. 2.
[10] A Proposal for School Bus Safety Training Program (Albany: New York State Education-Department, 1985), p. 1.
[11] "School Bus Fleet Survey of State Directors of Pupil Transportation," School Bus Fleet_Magazine, February/March 1986, pp. 16-19.
[12] The information in this section is taken from New York State Education Department fact sheet, 1984-85 school year.
[13] Accident Facts (Chicago: National Safety Council, 1985), p. 90.
[14] Transcript of "A Public Hearing on the topic: School Bus Safety: Has New York State Gone as Far as it Can, Should or Must Go? Before the New York State Legislative Commission on Critical Transportation Choices, Statement of Senator Norman J. Levy, New York, November 14, 1983." (Hereinafter cited as Hearings)
[15] Hearings, December 8, 1983 (Statement of Agnes Kalemaris, Suffolk County District Parent-Teachers Association).
[16] School Bus Safety and Seat Belts (New York: The Institute for Safety in Transportation, 1985), p. 2.
[17] New York Laws of 1983, Ch. 635 and New York Transportation Law, § 140(5) (McKinney 1985).
[18] National Traffic and Motor Vehicle Safety Act of 1966, 88 Sta. 1470, 15 U.S.C. § 1391 et. Seq. (1985)
[19] 49 CFR §§ 571.217-571.222 (1985).
[20] School Bus Safety in New York State ... Children at Risk? (New York: Legislative Commission on Critical Transportation Choices, 1985), p.5.
[21] School Bus Safety in New York State, pp. 12-20.
[22] Testimony of William T. Gardner in Round Table Discussion, p. 13.
[23] Ibid, p.14.
[24] Ibid, pp. 14-15.
[25] Ibid
[26] Ilbid, pp. 52-53.
[27] Letter dated December 23, 1985 to Chairman Norman J. Levy of the Legislative Commission on Critical Transportation Choices from John D. States, M.D., Chairman and Professor, Department of Orthopaedics, University of Rochester and Chairman of the New York Coalition for Safety Belt Use, Incorporated.

[28] Letter dated March 13, 1986, to Chairman Norman J. Levy of the Legislative Commission on Critical Transportation Choices from John D. States, M.D., Chairman and Professor, Department of Orthopaedics, University of Rochester and Chairman of the New York Coalition for Safety Belt Use, Incorporated.
[29] Testimony of Jerome Palisi in Round Table Discussion, p. 18.
[30] The information in this section is derived from John Melvin and Kathleen Weber, Transport Canada School Bus Safety Study (Ann Arbor: University of Michigan, 1986), pp. 1-3.
[31] Ibid, p.3.
[32] Ibid
[33] Derwyn Severy, Harrison Brink, and Jack Baird, School Bus Passenger Protection (Los Angeles: University of California, 1967), p. 3.
[34] School Bus Safety and Seat Belts, pp. 2-3.
[35] National Highway Traffic Safety Administration, Safety Belts in School Buses (Washington, D.C.: United States Department of Transportation, 1985), p.7.
[36] Ibid
[37] Ibid
[38] Ibid, p. 10.
[39] Ibid
[40] Telephone conversation by Program Associate Dean Attanasio, Legislative Commission on Critical Transportation Choices, with Founder Carol Fast of the National Coalition for Seat Belts on School Buses, March 20, 1986.
[41] Ibid.
[42] Ibid.
[43] Transportation Handbook for Elementary Children (Greenburgh, New York: Greenburgh Central School District #7, 1983).
[44] National Coalition for Seat Belts on School Buses, "Suggested Guidelines for Seat Belt Implementation in Large. Type I School Buses." P.O. Box 781, Skokie, Illinois 60076.
[45] School Bus Safety in New York State, pp. 12-20.
[46] National Coalition for Seat Belts on School Buses, "Suggested Guidelines for Seat Belt Implementation in Large Type I School Buses." P.O. Box 781, Skokie, Illinois 60076.
[47] Safety Belts in School Buses, p. 10.
[48] Ibid.
[49] Letter dated March 13, 1986 to Chairman Norman J. Levy of the Legislative Commission on Critical Transportation Choices from John D. States, M.D., Chairman and Professor, Department of Orthopaedics, University of Rochester and Chairman of the New York Coalition for Safety Belt Use, Incorporated.
[50] Safety Belts in School Buses, p. 13.
[51] Testimony of Suffolk County Executive Peter Cohalan, in Round Table Discussion.
[52] Ibid .
[53] Hearings, December 8, 1983 (Statement of Ronald Segedy, Assistant Commissioner, New York State Department of Motor Vehicles)
[54] School Bus Safety: Do Parents Have Reason to be Concerned (New York: Physicians for Automotive Safety, 1980), p. 1.
[55] Testimony of Michael Joyce, President, New York State Association for Pupil Transportation, in Round-Table Discussion, pp. 56-57.
[56] Telephone conversation by Program Associate Dean Attanasio, Legislative Commission on

Critical Transportation Choices with John D. States, M.D., Chairman and Professor, Department of Orthopaedics, University of Rochester and Chairman of the New York Coalition for Safety Belt Use, March 2, 1986.
[57] Ibid