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ROAD SAFETY BUREAU

**SCHOOL BUS
SAFETY
TASK FORCE**

**SAFETY OF
SCHOOL CHILDREN
NEAR BUSES**

MAY, 1992.

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GLOSSARY

BUS: Includes State Transit Authority bus, similar private bus, and long distance/tourist coach

FATALITY: A person who dies within 30 days of an accident from injuries received as a result of that accident

OTHER TRAFFIC UNIT A FACTOR: The traffic unit (in this case the school bus) is a factor in the accident without being directly involved in any impact.

ROAD SAFETY BUREAU CRASH DATA BASE : The accident statistics included in this data base are confined to those accidents which conform to the national guidelines for reporting and classifying road vehicle accidents. The main criteria are:

- the accident was reported to the Police
- the accident occurred on a public road
- the accident involved at least one moving road vehicle
- the accident involved at least one person being killed or injured or at least one vehicle being towed away

SERIOUSLY INJURED: A person who is injured and admitted to hospital as a result of an accident.

1.0 INTRODUCTION

The Task Force on School Bus Safety was formed by the Road Safety Bureau at the request of the Minister for Roads, following a double fatality in September 1990, when two children were struck by a car while crossing the road to their home after getting off a school bus.¹

The Task Force's terms of reference were to propose measures to improve the safety of transporting children to and from school by bus. Both the pedestrian and in-vehicle phases of the journey to school were to be considered.

The pedestrian phase was selected for initial investigation and this report sets out the subsequent findings of the Task Force and makes recommendations to improve the safety of pedestrian traffic around school buses.

2.0 METHODOLOGY

A multidisciplinary approach was adopted to this issue. The task force comprised of engineers, geographers, behavioural scientists and educationalists, and represented each of the key areas of the Road Safety Bureau. (Appendix A).

The study method was to:-

- determine the number of children aged 5-18, injured in NSW in accidents which involved a (school) bus during school travel time;
- determine the characteristics of the accidents;
- review practice in other jurisdictions, both within Australia and overseas;
- identify countermeasures;
- recommend the most suitable countermeasures.

1. It should be noted, in retrospect, that this incident did not in fact involve the school bus. The NSW Coronial Inquiry found that the bus had proceeded along its route, had made further stops, and was well out of sight when the collision occurred.

3.0 PROBLEM IDENTIFICATION

3.1 Accident and Casualty Data Analysis

Data was obtained for 1988 and 1989 from the Road Safety Bureau accident data base for all pedestrian casualties in which:

1. a bus was "involved" or was "a factor" (see Glossary);
2. the pedestrian was aged between 5 and 18 years (school age);
3. the accident occurred between 7.30 to 9.30 am or 3 to 5 pm on school days.

A summary of the data collected is contained in Appendix B.

In General

During 1988 and 1989 there were a total of 107 child pedestrian casualties involving a bus during "school travel" hours. In only three cases was more than one pedestrian involved in an accident.

Five children were fatally injured, 38 seriously injured (admitted to hospital), and 64 had minor injuries.

Age

Most of the casualties (65 %) were aged 12 or less. Seventy five percent of those seriously injured or killed were in this age group. The 13-15 year old group accounted for the remaining serious casualties. There were no 16, 17 or 18 year olds seriously injured or killed.

There appear to be peaks in the number of these crashes for ages coinciding with the early years of Primary school and the early years of Secondary school. This may indicate an over-representation of *inexperienced* bus travellers, where the lower school order may have been within walking distance but the next level requires bus travel.

The 107 casualties represent 4.3 percent of all pedestrian casualties for this age group and 10 percent of all pedestrian casualties in the "school travel" hours.

Time of day

Ninety four (88%) of the 107 casualties occurred in the afternoon period.

With respect to all pedestrian accidents for this age group in the morning and afternoon periods, 4% were school bus related in the morning and 13% were school bus related in the afternoon.

Road User Movements

Most accidents involved vehicles other than the bus striking the child.

In almost three quarters of the 107 casualties, the bus had acted as a visual obstruction which made it difficult for the drivers of the striking vehicle and the child to see each other until it was too late. This type of accidents can be broken down into:

- Pedestrians who appeared from the *front* of the bus and are struck by a vehicle travelling in the *same direction* to the bus accounted for about half of the 107 pedestrian casualties. No fatalities were involved in this type of accident. All of these casualties occurred in 60 km/hr speed zones.
- Pedestrians who appeared from the *rear* of the bus and are struck by an *oncoming* vehicle (travelling in the opposite direction to the bus) account for 23 of the 107 pedestrian casualties. These accidents accounted for 10 of the 38 serious injuries and 3 of the 5 fatal injuries. This was the predominant accident category for 80 km/hr and 100 km/hr speed zones.

Many of the children were described as "running" at the time of the collision.

Summary

In summary, the school bus pedestrian problem is mainly one of:-

- children aged 15 and under;
- children returning from school or after school activities;
- children emerging from in front of or from behind a bus into the path of an approaching car.
- children running in the vicinity of a school bus into the path of an approaching car.

3.2 Effect of the Bus

As stated above, 88% of the casualties occurred in the afternoon period. The sequence of events and the relationships between the students and the bus can explain the difference between morning and afternoon casualty rates

In the morning children are either at the bus stop *before the bus arrives* or cross the road *towards* the bus. In these circumstances the bus doesn't act as a vision block to either motorists or pedestrians.

In the afternoon, however, the children are moving away from the bus, and dispersing in all directions. If they are crossing the road *while the bus is still present*, there is the potential for both the child's and the motorist's view to be obscured by the bus. Croft estimated that the presence of a school bus could increase the probability of a child being struck by a factor of about 6. (Croft, 1976)

Road geometry and the selection of the site for the bus stop can also affect sight lines, and therefore, safety. [An analysis of the effect of the bus on sight lines is contained in Appendix C.]

The influence of the bus can be critical in three common situations, namely:-

1. Vehicle travelling in the **same direction** passing by a stationary bus: child crosses from in front of bus.

Unless the passing vehicle is travelling at a *very* slow speed there is little opportunity to avoid an impact with the child emerging from the front of the bus. For a running child, the vehicle would need to be travelling at less than the speed of the child if an impact was to be avoided. Anecdotal evidence suggested that on many occasions the passing vehicle had slowed considerably, so as to pass the bus with caution, yet was still unable to avoid a collision with the emerging child.

2. Vehicle travelling in **opposite direction** to bus: child crosses from behind *stationary* bus.

This situation is less critical in terms of available reaction time, but tends to produce a more severe impact. The vehicle approaching the bus can be travelling at four to five times the speed of the vehicle in the first situation and still avoid an impact.

3. Vehicle travelling in **opposite direction** to bus, which is moving off to continue its journey: child crosses from behind *moving* bus.

The analysis also shows the deleterious effect on sight lines of the bus pulling out onto the road. A bus which has travelled 70 metres can still be obscuring a pedestrian on the edge of the road from motorist travelling in the opposite direction to the bus. Oncoming vehicle speeds tend to remain high but 'avoidability' is dramatically reduced with the pedestrian often well onto the carriageway.

4.0 CURRENT PRACTICE

With these scenarios in mind, existing practice in NSW, other Australian States, and overseas was reviewed. The aim was to assess current practice in NSW and to identify countermeasures which are used elsewhere.

4.1 New South Wales

Information collected on current practice in NSW is contained in Appendix D.

The Road Safety Bureau's education unit has developed various initiatives for teaching school bus safety to school children.

There are education programs for preschool, infants and primary school children. These programs also aim to involve the parents in the topic by the use of take home notes and parent sheets. The key messages being conveyed in the programs are:

a) Primary and infants,

- "Wait until the bus has driven off before choosing the safest place to cross the road."
- "It is usually safest to wait until the bus has driven away before choosing the safest place to cross."
- "Never run onto the road in front of or behind the bus."

b) Preschool,

- "Hold the hand of the adult with you when waiting for the bus."
- "Wait for the bus well back from the kerb."
- "It is not safe to run or play when waiting for the bus".
- "Wait until the bus has driven off before choosing the safest place to cross the road."
- "Never run onto the road in front of or behind the bus."

School buses in NSW country areas are required to display a "school bus" sign at the rear and to use four-way flashing hazard lights (if fitted) when stopping for school children. These measures were implemented following a study conducted by the NSW Traffic Accident Research Unit in 1977 which examined the safety of school children at bus stops (Croft, 1977).

There are also guidelines for the safe location of school bus stops³.

Following the double fatality, which prompted the establishment of the School Bus Safety Task Force, there were also calls from some sectors of the community for buses in NSW to be fitted with flashing lights and signs similar to those used on school buses in the United States. (see 4.3)

3. *Interim Guidelines for the Planning and Design of School Bus Routes and Bus Stops.*
Traffic Authority of NSW, June, 1988.

4.2 Australia

A survey form was sent to each Australian State and Territory to determine current countermeasures and to seek comment on possible countermeasures for school bus safety. The survey form and results are set out in Appendix E.

In summary, all the respondents have pedestrian safety education programs directed at school children. All respondents require "School Bus" signs on dedicated school buses. Two States require additional external mirrors to improve the driver's view of pedestrians. Most States have guidelines (generally informal) about the location of bus stops with regard to traffic safety and some apply special speed limits in the vicinity of school bus stops.

4.3 United States

Comprehensive information about school bus safety measures is available for the United States. Information about other countries is scarce, perhaps because such issues are usually dealt with at a local level.

The US Transportation Research Board recently published a special report "Improving School Bus Safety" (Number SR222). This contains a description of practices and policies in most US states and an evaluation of a wide range of countermeasures.

Standards vary considerably between the states. Some require the bus to be fitted with an octagonal "stop" sign which swings out when the bus stops. Other motorists, both passing and oncoming, are then required to stop. In one state the bus driver is required to switch the engine off and escort children across the road.

Some states require school buses to be fitted with a swing-out pedestrian barrier to discourage children from crossing in front of the bus.

Most of the regulations require that the buses activate high mounted rear flashing red lights when children are embarking or disembarking.

It should be noted that the buses used to transport children, and to which these regulations refer, are specially designed and solely used for the transport of school children. They are painted a bright yellow colour which is designed to be highly visible and which clearly identifies them to other motorists as school buses. Only active school buses can use (or retain) that distinctive colour.

Furthermore, the rear of all school buses (indeed the whole bus) are free of visual clutter such as advertising.

5.0 DISCUSSION

School buses are an important mode of transport for children travelling to and from school in NSW. The hazards children are exposed to when disembarking from buses have long been recognised and education programs have been designed to make children aware of these hazards.

The fact that children are being injured while running across the road, without waiting for the bus to leave, is evidence that for them, the principles taught through the school bus education program have not been applied. The messages may not have been remembered or acted upon when most needed.

A useful strategy would be to provide targetted reinforcement of the education message as close as possible to the time it is needed. This needs to be done immediately before or after the students leave the bus, possibly by the bus driver, other students, parents/carers, or perhaps reminder notices near bus exits.

If the pedestrians still attempt to behave in a manner that places them at risk, attention needs to be given to providing interactive supervision by more responsible people and to assisting the drivers of other vehicles to take action which can prevent an accident.

The responsible people who may be present when a child disembarks from a bus are the driver, older students, a monitor, or parents. Potential for reinforcement and/or intervention at this crucial time may be realised through any or all of these groups.

Almost 90 percent of the accidents occurred when the child was returning from school or after school activities. Parents could be made more aware of the vulnerability of children at this time. Parent education could also include a warning of the hazards of standing on the *opposite* side of the road to the bus stop. They may inadvertantly act as a distraction, or focus, to the child crossing the road.

Special traffic control regulations in the vicinity of school buses have often been suggested as a countermeasure. However, measures designed to stop vehicles passing school buses, or significantly reduce their speed, have been shown to be of limited effectiveness, and may produce harmful side effects.

United States experience indicates that about 14 percent of vehicles passing the bus do not stop as required to do by regulations. The use of a "Stop" sign on the side of the bus improves the compliance rate by only a further 4 percent (SR222, 1989). 'Enforcement' often lies with bus drivers noting down registration and driver details of any offending vehicle. The registered owner then receives a warning letter. Police action only occurs if an offence is witnessed by a Police Officer or if a driver is reported repeatedly.

Previous studies in NSW (Croft, 1977; Schnerring, 1980) and an assessment of a similar law in New Zealand (New Zealand Road Safety, 1976) also questioned whether such an approach would have any demonstratable benefits due to poor compliance and enforcement difficulties.

Furthermore, such regulations have the potential to increase the casualty rate because of the relatively poor compliance and the possibility that such regulations may lead to a false sense of security amongst school children, especially during the necessary implementation period. They also have the potential, because of their disruptive effect on the traffic stream, to cause other serious crashes.

Warning lights may involve some practical problems in the traffic environment and on buses which are used in the major metropolitan areas of Sydney. There is, however, evidence to suggest that a viable flashing light system could be a useful tool in alerting other drivers to the presence and hazard potential of a school bus (Schnerring, 1980).

A trial was recently conducted of a prototype sign with integrated flashing lights designed to be attached to the rear of a bus. Following this trial, it was concluded that this sign may be of limited effectiveness on the rear of buses in the metropolitan area for the following reasons :-

- for the flashing light to be effective, a driver would virtually have to stop [producing the hazardous side effects discussed above], rather than merely slow down, *and* be aware of the possibility that a child may be about to cross from the front of the bus. (see Appendix C)
- an examination of the space available on the rear of STA buses showed that there would be very little space left for such a sign after the requirements for lights, other signs, advertising etc. had been met.
- there is considerable visual clutter on the rear of metropolitan buses. As a consequence flashing lights and a sign would have to successfully compete for the attention of a driver before they had any effect at all.

However, the Task Force determined that a warning sign and flashing light system mounted on the front of the bus and directed at **oncoming** traffic may prove an effective countermeasure. If educated to slow down and proceed with caution when given warning from the flashing lights on the school bus, **oncoming** drivers approaching the bus may be more able to avoid a child crossing the road from behind the bus. The effect of this warning could be maximised by leaving the flashing lights on for a short period after the bus has left the stop.

Should a collision still be unavoidable, the impact severity could be greatly reduced due to the decrease in vehicle speed. This type of accident produced most of the fatalities studied and was dominant in higher speed zones (80-100km/h).

The necessary approach to reducing front crossing/passing vehicle collisions, is to **prevent** school students walking in front of the bus.

In some parts of the United States, buses are fitted with a barrier which swings out from the front of the bus to prevent pedestrians walking in front of the bus. The task force considered that this may be impractical on buses operating in the metropolitan area (where most accidents of this type occur) and may generate operational difficulties. However, some form of warning notice mounted on a small 'barrier' may warrant further investigation.

The use of sensors to detect the presence of a pedestrian was seen as having the potential to be practical and effective. Such a sensor would automatically trigger an alarm or recorded message if a pedestrian attempted to walk in front of the bus. This audible reminder was seen as being a reinforcement of the education message and an indication to the driver or another responsible person that an unsafe act was taking place. A US device was trialled at the Road Safety Bureau but it did not prove entirely suitable for the intended purpose. Future development of a specially designed device would warrant further trials.

If provided with a loudspeaker, drivers could also warn the child not to cross the road in front of the bus and to wait until the bus has left before crossing the road. Alternatively, or additionally, monitors stationed at the front bus exit could prevent students walking in the front of the bus as they disembarked.

Guidelines for the location of school bus stops are available and are used by the relevant authorities. However, there appears to be some confusion as to the responsibility for establishing the location of bus stops. Nevertheless, the guidelines presently available may be used to audit the existing routes and stops and for the determination of new routes and stops. A revision and expansion of these guidelines may also be beneficial.

6.0 STRATEGIES and COUNTERMEASURES

While the school bus pedestrian problem remains a relatively small component of the total road safety picture in NSW, it is a problem with definable elements which may be amenable to cost effective countermeasures.

The Task Force considered that the greatest improvements in pedestrian safety associated with school buses could be achieved by reducing the *frequency* of "vehicle overtaking/front of bus" accidents and the *frequency and severity* of "oncoming vehicle/behind bus" casualties.

The optimum is to ensure that the child does not cross the road until the bus has moved away and is no longer an obstruction to vision. If the child does cross the road while the bus is present, it is preferable that this is done from the rear of the bus AND that oncoming drivers approaching the bus are alerted to the presence of school children *and reduce speed accordingly*. Crossing from in front of the bus should be prevented at all costs.

Strategies were based on the 4 key areas of

- EDUCATION
- MANAGEMENT OF STUDENTS ON/NEAR BUSES
- DESIGN/MECHANICAL ASPECTS OF BUSES
- ROAD ENVIRONMENT

A range of existing and possible countermeasures were identified. Those which were thought to be most applicable to the situation in NSW are:-

A. EDUCATION

<u>Target</u>	<u>Message</u>
School children	<ul style="list-style-type: none">• wait until the bus has left before crossing the road• never cross the road from in front of the bus
Bus driver	<ul style="list-style-type: none">• know the hazards that can exist for child pedestrians• be aware of the correct behaviour for child pedestrians
Parents / Carers	<ul style="list-style-type: none">• be aware of the limitations of a child's ability to cope with traffic at different stages of development• be aware of the correct behaviour for child pedestrians• wait at the bus stop, not on the other side of the road
Motorists	<ul style="list-style-type: none">• be aware of childrens behaviour and of the meaning of warning signs and lights• exercise caution when approaching a school bus from <i>any</i> direction

B. MANAGEMENT OF STUDENTS ON/NEAR BUSES

Supervisors On Buses	<ul style="list-style-type: none">• reinforce education messages (older children and/or volunteers)• prevent children crossing in front of bus
Drivers	<ul style="list-style-type: none">• reinforce education messages, especially crossing after the bus has left• prevent children crossing in front of bus
Parents / Carers	<ul style="list-style-type: none">• reinforce education messages• wait on the <i>same side</i> of road as the bus stop

C. SCHOOL BUS DESIGN/MECHANICAL ASPECTS

Warning sign and flashing light system to alert **oncoming** motorists to the presence of child pedestrians

Auxillary mirrors to improve the bus driver's vision across the front of the bus

Prohibit all advertising on the rear of any bus used to transport school students

External loudspeaker to allow bus driver to communicate with pedestrians

Warning/reminder stickers place inside bus near bus exits

D. BUS STOP/ROUTE ENVIRONMENT

Location of school bus stops

- avoid locations which exacerbate the visibility problems of drivers and pedestrians.

School bus routes

- select the most appropriate route with respect to demand and bus stop locations to minimize pedestrian hazards and reduce the number of road crossings needed.

7.0 CONCLUSIONS

While the number of school students injured and killed as pedestrians near school buses is a relatively small part of the overall road safety problem, it is an area that is particularly tragic to families who experience such losses, as well as an important issue for the wider community.

This concern for the safety of school students is often expressed to the relevant Ministers and is a key area of attention for Government agencies. Injuries to school child pedestrians in NSW can be reduced by a concerted joint effort on several fronts. While the Road Safety Bureau is rightly expected to provide a lead role in this area, it is an issue which requires the co-operation of all those concerned.

The Road Safety Bureau's investigations highlighted the key scenarios of front crossing/passing vehicle and rear crossing/oncoming vehicle collisions. It is the rectification of these situations which would reap the greatest rewards in reducing and preventing these casualties.

The recommendations of the School Bus Safety Task Force are designed to achieve significant progress in regard to this issue with realistic and applicable countermeasures. The community will play an important role in ensuring that this issue is actively addressed, with the safety benefits carrying over to future generations.

8.0 RECOMMENDATIONS

At this stage in the continuing efforts to improve school bus safety, the School Bus Safety Task Force recommends that :

- the Road Safety Bureau encourage a unified inter-departmental approach to school bus safety issues involving all stakeholders.
- children be prevented from crossing the road from in front of a bus after alighting through:
 - providing auxillary mirrors to improve the bus driver's vision across the front of the bus so they may intervene;
 - encouraging older students or volunteers to act as supervisors on buses to reinforce education and physically prevent front crossing;
 - further investigating :
 - an automatic sensor system which can provide an immediate auditory warning when pedestrians cross in front of the bus;
 - some form of small fold-out barrier;
 - an external loudspeaker system to allow the bus driver to communicate with pedestrians.
- crossing the road from the rear of a bus be made less hazardous through fitting school buses in non-metropolitan areas with an additional flashing light system on the front, to warn *oncoming* motorists of the possible presence of children.
- the school road safety education program continue to :
 - incorporate a bus travel component to develop a basic knowledge of school bus safety in all school children;
 - emphasise the need for students to wait until the bus has left before attempting to cross the road.
- additional efforts be directed toward making parents more aware of the vulnerability of children when returning from school and the hazards of waiting on the *opposite* side of the road to the bus stop.
- the possible use of reminder warnings near bus exits to reinforce the education messages at the time most needed be investigated further.
- the removal of advertising from the rear of any bus used to transport school students be investigated.
- steps be taken to ensure that the location of school bus stops is consistent with the Road Environment Safety Guidelines and does not exacerbate the problem of pedestrian visibility.
- the Road Safety Bureau initiate a revision and expansion of the 1988 *Interim Guidelines for the Planning and Design of School Bus Routes and Bus Stops*. (Traffic Authority of NSW) .

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APPENDICES

APPENDIX A : Task Force

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APPENDIX B : Accident Data

Data Summary

Child Bus Casualties 1988-1989

Speed	Type of accident	Degree of Casualty		
		Killed	Seriously injured	Other injured
60 km/h	Emerge Front	0	17	33
	Emerge Rear	1	5	6
	Ran into path	1	2	5
	Other	1	6	10
	Total	3	30	54
80/100 km/h	Emerge Front	0	3	1
	Emerge Rear	2	5	2
	Ran into path	0	0	1
	Other	0	0	3
	Total	2	8	7
? km/h	Total	0	0	3
TOTAL		5	38	64

Type of Accident	Killed	Seriously Injured	Other Injured	Total	% Serious Casualties
Emerged front bus	0	20	35	55	37
Emerged rear bus	3	10	10	23	57
Ran into path of bus	1	2	6	9	44
Hit by bus on footpath	0	0	4	4	0
Fell while boarding	0	1	2	3	33
Hit by bike	0	0	1	1	0
Bag caught in door	1	0	0	1	100
Bus against red light	0	0	1	1	0
Car overtook bus on ped. crossing	0	0	1	1	0
Ran for bus, car hit	0	1	0	1	100
Other	0	4	4	8	38
Total	5	38	64	107	40

CHILD BUS CASUALTIES 1988-9

PEDESTRIAN CASUALTIES

Data were obtained for 1988 and 1989 for all pedestrian casualties in N.S.W. in which:

1. a bus was "involved" or "a factor" (using categories of Analysis Unit)
2. the pedestrian was aged 5 to 18 years
3. the accident occurred during the hours 7.30am to 9.30 am or 3 pm. to 5 pm on school days.

Altogether there were 5 fatalities and 102 children injured, 38 of whom were admitted to hospital. The involvement of a **school** bus was specifically mentioned in 31 incidents.

The 107 casualties represent 4.3% of all pedestrian casualties for this age group.

Type of accident

55 children walked or ran in front of a bus and were hit by car overtaking bus from rear.

23 children appeared from rear of bus and were hit by car travelling in opposite direction to bus.

9 resulted from the child running or walking into the path of a bus and being hit.

1 involved a child on a pedestrian crossing who was hit by a car overtaking the bus

In 4 cases the bus hit a pedestrian on the foot path or verge

3 were the result of children being pushed under the bus as they tried to board the bus

1 fatality was caused by the child's bag being caught in the bus door and the child falling under the bus

1 child was hit by a car while running across the road to board the bus

1 child was hit by a motorbike which overtook a stationary bus on the curb side as the child was alighting

In 1 case the bus proceeded through a red light and hit a child crossing the road.

The remaining cases gave too little information to be categorised.

Time of day:

7.30 am to 9.30am	13
3pm to 5pm	94

Sex

60 of those killed or injured were males and 47 were females

Severity of casualty by type of accident.

Table 1

Type of accident	Killed	Seriously injured	Other injured	Total	% serious casualties
Emerged front bus	0	20	35	55	37
Emerged rear bus	3	10	10	23	57
Ran into path of bus	1	2	6	9	44
Hit by bus on footpath	0	0	4	4	0
Fell while boarding	0	1	2	3	33
Hit by bike	0	0	1	1	0
Bag caught in door	1	0	0	1	100
Bus against red light	0	0	1	1	0
Car overtook bus	0	0	1	1	0
on ped. crossing					
Ran for bus, car hit	0	1	0	1	100
Other	0	4	4	8	38
Total	5	38	64	107	40

Severity of casualty by speed limit

Table 2

	Killed	Seriously Injured	Other Injured	Total
60k/hr	3	30	54	87
80k/hr	0	1	2	3
100k/hr	2	7	5	14
Speed unknown	0	0	3	3

Table 3

Speed, type of accident and degree of casualty

Speed	Killed	Seriously injured	Other Injured
60 km/h			
Emerge Front	0	17	33
Emerge Rear	1	5	6
Ran into path	1	2	5
Other	1	6	10
	3	30	54
80/100 km/h			
Emerge F	0	3	1
Emerge R	2	5	2
Ran into	0	0	1
Other	0	0	3
	2	8	7
? km/h			
	0	0	3
TOTAL	5	38	64

Age	Killed	Seriously injured	Other injured	Total
5	1	5	4	10
6	0	2	5	7
7	1	3	7	11
8	1	3	5	9
9	0	4	3	7
10	0	2	1	3
11	0	5	1	6
12	0	5	12	17
13	0	5	7	12
14	1	2	8	11
15	1	2	5	8
16	0	0	3	3
17	0	0	1	1
18	0	0	2	2

Day of week

Mon	30
Tues	22
Wed	23
Thurs	19
Fri	13

Traffic flow

The traffic flow in areas where the accident occurred was:

Light	55
Medium	35
Heavy	16
Unknown	1

Location

48 casualties (45%) occurred in the Sydney metropolitan area.

BUS PASSENGER CASUALTIES

Data for 1988-89 were analysed for all accidents in N.S.W. where:

1. a bus passenger aged 5 to 18 years was involved and
2. the accident occurred during the hours 7.30am to 9.30 am or 3 pm. to 5 pm on school days.

There were 104 casualties comprising one fatality, 4 serious injuries and 99 other injuries.

APPENDIX C: Vehicle/Pedestrian Conflict

EFFECT OF THE BUS ON MOTORISTS VISIBILITY OF PEDESTRIANS

This analysis is based, in part, on a paper titled "The hidden pedestrian - an aspect of risk at uncontrolled crossings" by Mr Peter Croft, presented at the 1976 ARRB Conference.

The analysis looks at three situations where the bus obscures a motorist's view of a pedestrian who is attempting to cross the road after disembarking from the bus.

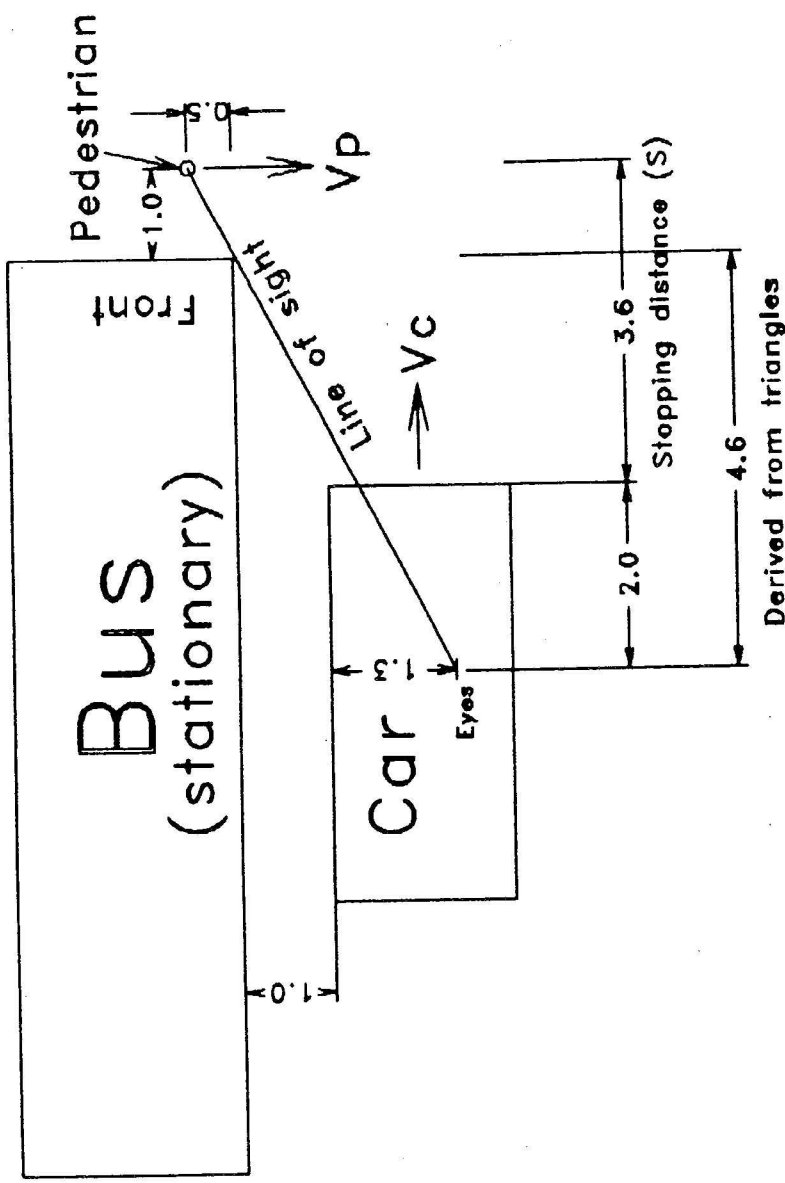
Case 1 involves the pedestrian crossing the road just in front of the bus. A car is overtaking the bus but the driver is unable to see the pedestrian due to the presence of the bus. The analysis assumes that the pedestrian is 1 m ahead of and 0.5 m inboard from the offside front corner of the bus when first spotted by the motorist (it should be noted that the analysis is highly sensitive to these initial conditions, due to the close proximity of the pedestrian to the front of the bus). The question is, what is the maximum speed that the motorist can be doing in order to stop for the pedestrian? Taking in account the initial reaction time of 1.5 s (Croft, 1976), the average deceleration of a typical car under good conditions and the geometry of the situation (see Figure for "Case 1"), the maximum speed is estimated to be only 8 km/h.

Case 2 is similar to Case 1, except that the motorist is travelling in the opposite direction and the pedestrian crosses at the rear of the bus. In this case the rear of the bus obscures the motorist's view of the pedestrian (see Figure for Case 2). This analysis assumes that the pedestrian is 2 m rearward of the bus and 0.5 m inboard from the rear offside corner (the longitudinal value is larger than that in Case 1 because there is more likely to be clear space at the rear of the bus). Again the analysis is very sensitive to these initial conditions. In this case the maximum speed of the on-coming motorist is determined to be 28 km/h. As expected, this is higher than that for an overtaking vehicle (which is closer to the side of the bus) but it is still much lower than typical traffic speeds.

Case 3 looks at the prolonged effect of a bus departing from the bus stop. As the bus swings back into the traffic lane it continues to obscure the pedestrians from on-coming motorists for a substantial distance. Assuming that the pedestrian is already 1m from the kerb and that the on-coming vehicle is travelling at 80 km/h, then for the geometry illustrated in the figure for Case 3, the bus must travel at least 64 m in order for the on-coming car to be able to stop in time, after the pedestrian comes into view.

ILLUSTRATION OF EFFECT OF BUS ON SIGHT DISTANCES

Case 1: Overtaking car, pedestrian at front of bus



$$S = V_c * T + (V_c * V_c) / (2 * a) \text{ metres}$$

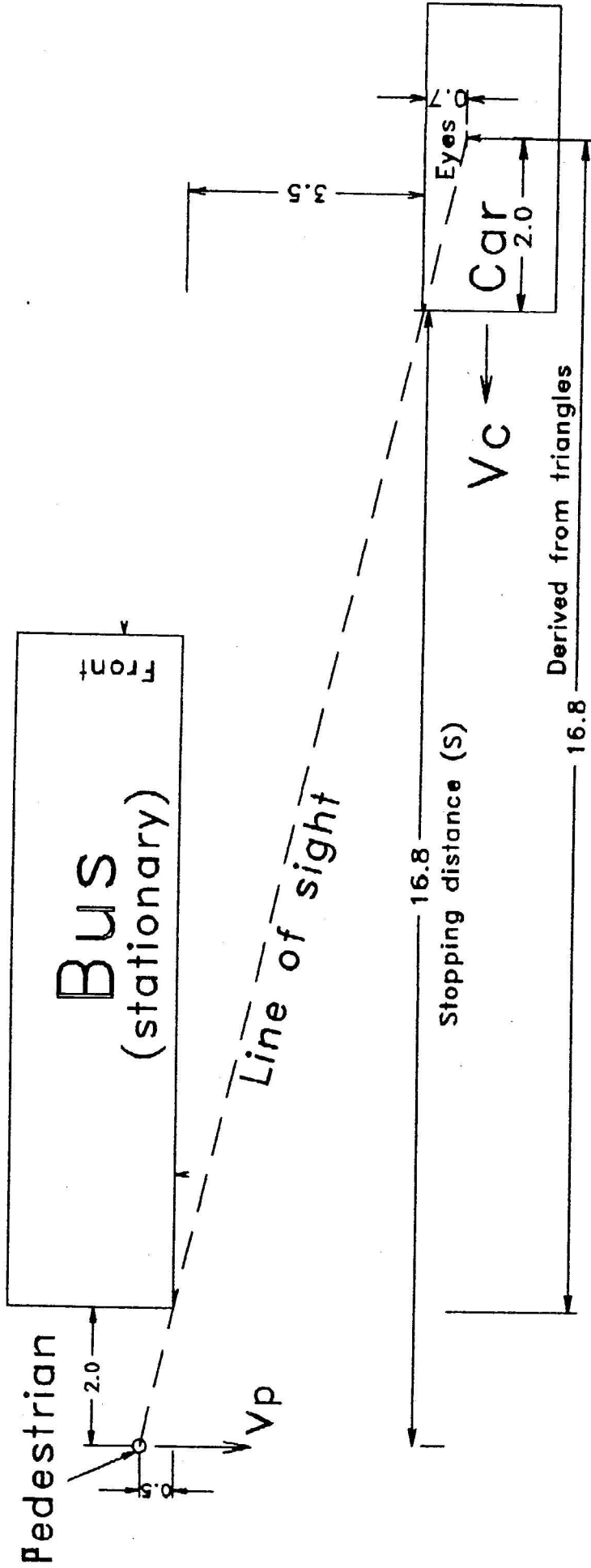
Where T is driver reaction time

a is average vehicle deceleration (m/s/s) 6.2 m/s/s for a car

For $S = 3.6\text{m}$ (the available stopping distance) $V_c = 7.75 \text{ km/h}$
 (the car can be travelling at no more than 8 km/h in order to stop)

ILLUSTRATION OF EFFECT OF BUS ON SIGHT DISTANCES

Case 2: Oncoming car, pedestrian at rear of bus



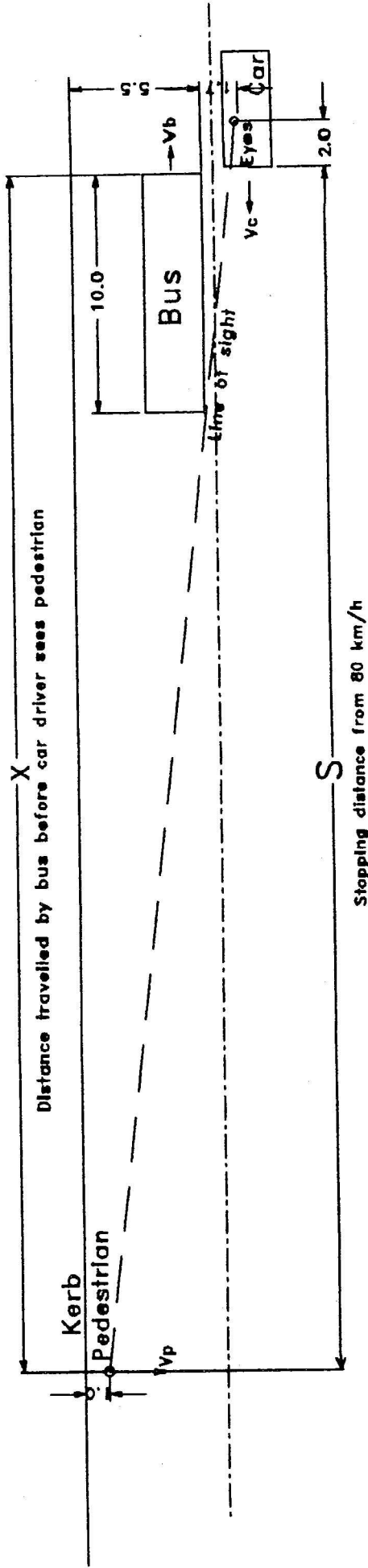
$$S = V_c * T + (V_c * V_c) / (2 * a) \text{ metres}$$

Where T is driver reaction time

a is average vehicle deceleration (m/s/s) 6.2 m/s/s for a car

For $S = 16.8\text{m}$ (the available stopping distance) $V_c = 28.3 \text{ km/h}$
 (ie car can be travelling at no more than 28.3 km/h in order to stop)

Case 3: Bus pulls out and obscures pedestrian from on-coming motorists



$$S = V_c * T + (V_c * V_c) / (2 * a)$$

Where V_c is car initial speed (80km/h = 22m/s)

T is driver reaction time (1.5 seconds)

a is average vehicle deceleration (6.2 m/s/s for a car)

For these initial conditions, stopping distance = 72m

From trigonometry, $X = 10 + (5.5 - 1) * (S + 2) / (5.5 + 1.7 - 1) = 64 \text{ m}$

That is, the bus must travel at least 64 m before the car driver is able to see the pedestrian

APPENDIX D : NSW Practice

SCHOOL BUS ROUTES : Responsibility for school bus routes is unclear. It is not a responsibility of the Department of Education. The Department of Transport and STA see it as a responsibility of Local Area Traffic Committees.

Local Area Traffic Committees are convened by local councils and include representatives from the RTA and Police. These representatives have voting rights. They have responsibility for making decisions in a broad range of matters which include the establishment of the location of school bus stops. Interested parties, such as the STA and the Bus Operators Union, can provide input to the committee and their views are considered when determining the location of stops. The Ministry of Transport and Planning's Technical Document No. 19, "Planning Bus Services" and the RTA's "Interim Guidelines for the Planning and Design of School Bus Routes and Bus Stops" is also used as a reference.

EDUCATION : The Road Safety Bureau's educational unit has developed various initiatives for teaching school bus safety to school children.

For children in preschools the bus safety messages are contained in the Kids and Traffic Kit. The messages in this kit focus on the need for close adult supervision and the childrens' behaviour while waiting for the bus, entering and exiting the bus, riding on the bus and crossing the road after getting off. The role of parents and carers is an important one and is represented in this program. A parent note is being developed and has been designed to be handed out by the preschool staff when they are discussing the topic of bus safety, it is to support what is being done in the centre and to actively involve the parents with their children in a fun activity that also gives them the basic messages of bus safety. The basic messages are:

- "Hold the hand of the adult with you when waiting for the bus."
- "Wait for the bus well back from the kerb".
- "It is not safe to run or play when waiting for the bus."
- "Wait until the bus has driven off before choosing the safest place to cross the road."
- "Never run onto the road in front of or behind the bus."

For children in primary school these messages are contained within the Street Sense Kit and the Calendar. The information contained in these materials predominantly focuses on the childrens' behaviour on the bus with respect to their conduct and takes the form of take home notes, work sheets and a storybook.

Regarding Pedestrian safety, the following messages are used:

- "Wait until the bus has driven off before choosing the safest place to cross the road."
- "It is usually safest to wait until the bus has driven away before choosing the safest place to cross."
- "Never run onto the road in front of or behind the bus."

For children in secondary school, there is nothing specifically relevant to school bus safety at this stage.

APPENDIX E1 : Survey Form

SURVEY OF SCHOOL BUS SAFETY MEASURES ROADS AND TRAFFIC AUTHORITY OF NSW

A. EDUCATION Including brochures, lectures, kits, advertising etc

Targets:

School children - pedestrian safety	YES/NO
other child education	YES/NO
School bus drivers (special programs)	YES/NO
Parents - safe practices near bus stops	YES/NO
other parent education	YES/NO
Motorists (caution near bus stops etc)	YES/NO
Other education	YES/NO
Comments	
.....	

B. SUPERVISORS/MONITORS - Volunteers to supervise children

Bus stops at school	YES/NO
Bus stops away from school	YES/NO
On buses	YES/NO
Other supervision	YES/NO

C. BUS DESIGN (Unique to state/territory)

"School bus" sign(s)	YES/NO
Rotating flashing lamps (amber?)	YES/NO
Use of hazard warning lights	YES/NO
Other lighting systems	YES/NO
Extra mirror(s) for driver's view of pedestrians	YES/NO
Devices (sensors) to detect pedestrians	YES/NO
External loudspeakers for use by bus driver	YES/NO
"Stop" arm to swing out and stop motorists	YES/NO
Pedestrian barrier at front of bus	YES/NO

E. POLICY/REGULATIONS

Other drivers to slow down/stop when a school bus stops	YES/NO
Bus driver to assist children to cross road (California)	YES/NO
Parents not to wait on "wrong" side of road	YES/NO
Are 3 children allowed per 2 adult seating positions on:	
normal school bus runs	YES/NO
excursions	YES/NO
Are standees allowed on:	
normal school bus runs	YES/NO
excursions	YES/NO
Comments	

TRIALS

Please describe any trials of counter-measures:

Reference:

Other comments/measures

Name: _____ Organisation: _____
State/Territory: _____ Phone: _____ Fax: _____

Thank you for your assistance. Please return completed form to PO Box 110 Rosebery NSW 2018 or fax to (02) 6624118 (Attention Michael Paine).

