



The safety benefits from seat belt use by heavy truck occupants

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Abstract

There has been much focus in recent times on the road safety hazard presented by heavy trucks. One issue that appears to have received little attention for heavy truck occupants compared to light vehicle occupants is in crash protection for heavy truck drivers and passengers through use of seat belts.

Seat belt use by heavy truck drivers became compulsory for the first time in NSW from 1 February 2000 as part of the move to national uniformity. Concerns were raised by the heavy truck industry about the removal of the exemption, and as a result the RTA commissioned research into the evidence around the safety benefits of seat belts and the current levels of use.

The research looked at data from the NSW crashed vehicle study, Australian and overseas crash research, and also interviews with a small group of truck drivers. An observational survey of seat belt use by heavy truck occupants was also undertaken. The results will be presented, which overwhelmingly supported the safety value of seat belts for truck occupants, and the need to increase wearing rates. Possible directions for increasing seat belt use will also be represented, including the use of education and enforcement.

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Introduction

It has long been accepted in Australia that for light vehicle occupants seat belts are an effective road safety measure that prevent serious injury in a crash. The high level of support for seat belt use has resulted in extremely high wearing rates (eg 97.4% of light vehicle drivers in New South Wales 1999, excluding taxis (Johansen, 1999)) and the saving of many lives.

A similar attitude and support for seat belt use has not been evident amongst truck occupants in New South Wales (NSW).

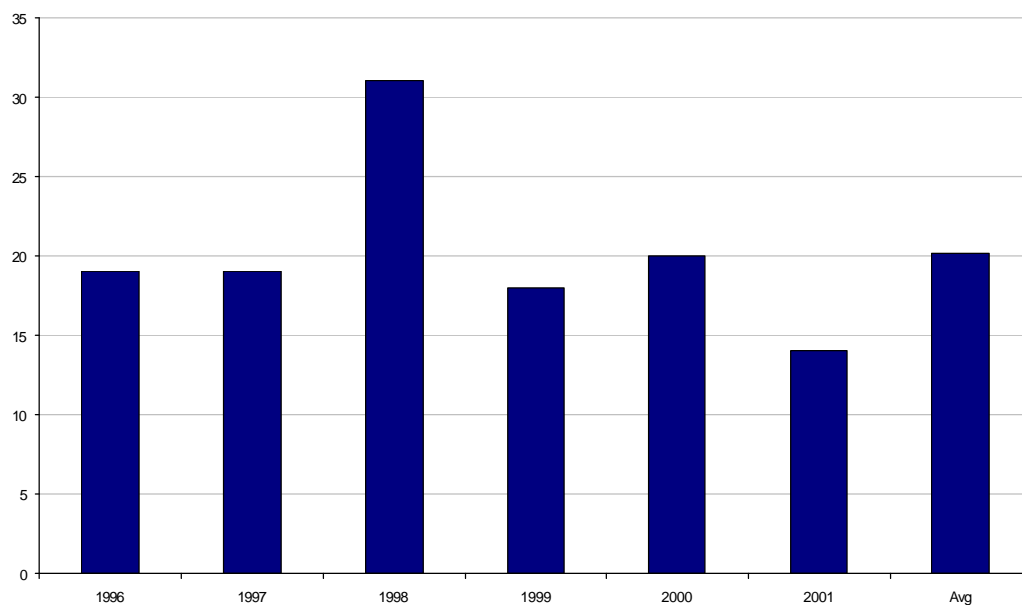
To investigate the level of seat belt use by truck occupants, the reasons for non-use of seat belts, and the protective value of seat belt use by heavy truck occupants, the Roads and Traffic Authority of NSW (RTA) commissioned a series of research studies.

This paper summarises the results of the research and points to possible next steps in improving the safety of truck occupants.

Background

Between 1996 and 2001 over 120 truck occupants, the vast majority drivers, were killed in crashes in NSW (see figure 1). Less than 10% were reported to have been wearing a seat belt.

**Figure 1. Number of heavy truck occupant fatalities
(NSW, 1996 to 2001)**



From the introduction of compulsory use of seat belts in NSW in the early 1970's, heavy vehicle drivers were exempted from seat belt wearing. The Australian Road Rules removed this exemption. With the removal of the exemption, however, some sectors of the transport industry in NSW expressed concern about the safety value of seat belts for truck occupants, and possible detrimental effects both in terms of safety and fines for non-use from the exemption removal.

In response to these concerns the RTA commissioned research into the attitudes and knowledge of truck drivers about seat belts, and the available crash evidence concerning seat belt effectiveness for truck drivers (Gibson, Benatos and Corbett, 2001). The RTA also undertook observational research to determine current seat belt wearing rates.

The results presented in this paper are based on the results from these studies.

Attitudes and knowledge of truck drivers to seat belt use

In-depth interviews were conducted with 7 truck drivers during mid 2001 to ascertain their attitudes, knowledge and self reported behaviour in relation to seat belt use while driving a truck. Each of the drivers consulted had over 20 years experience in driving heavy trucks. The Transport Workers Union provided the names of the drivers interviewed.

The drivers were asked questions including:

- The main reasons drivers had for not wearing seat belts;
- What makes drivers more or less likely to wear seat belts;
- What could make seat belts more acceptable to drivers.

Results

The drivers consulted were generally opposed to seat belt use by truck drivers. They indicated a number of reasons for their opposition to seat belt use, including:

- Restriction in the use of side mirrors. The drivers indicated that the belts sometimes lock and restrict their ability to check "blind spots" in their vehicle's side mirrors. Further investigation of this issue determined that older trucks tended to present more of a problem around this issue because of poorer ergonomics;
- Discomfort during normal driving. This mainly concerned air suspension seats and cabin mounted belts locking during normal driving;
- Inconvenience when performing deliveries;

- Impeding the driver's ability to move within or escape from the cabin in order to avoid injury during or after a collision;
- Difficulty in accessing and unlocking the seat belt; and
- Causing accidents when exiting the cabin by getting entangled in them.

Comment

The issues raised by the truck drivers are similar to those raised by light vehicle drivers in NSW prior to the introduction of compulsory seat belt use for light vehicle occupants. In a study conducted in 1971 (Freedman, Champion and Henderson, 1971) light vehicle occupants who said they never wore seat belts were asked the reasons why. Apart from the unavailability of a seat belt to use, the issues raised included:

- Seat belts are inconvenient and a nuisance
- Seat belts are unnecessary because they give no real protection
- Seat belts are dangerous

For light vehicle occupants, the proportion of people reporting these attitudes decreased significantly following the introduction of compulsory wearing (Freedman, Wood and Henderson, 1974), and the proportion of people supporting the safety value of seat belts increased. A similar change in attitudes appears to not yet have been achieved for truck drivers in NSW.

The issue around discomfort and access to the belt can be resolved by ensuring that an appropriate belt system is fitted for the type of vehicle. For example, where there are air suspension seats a seat mounted lap/sash seat belt.

The effectiveness of seat belts for truck occupants

Analysis of the NSW Crashed Vehicles Study Data

A Crashed Vehicles Study was undertaken in NSW between 1995 and 1998. The study involved the inspection of 4,426 randomly selected vehicles that had been involved in crashes where:

- A person had been killed or injured; or
- There was over \$500 damage to property other than the vehicle concerned; or
- One of the parties failed to stop and exchange particulars; or

- One of the drivers was reported to be under the influence of alcohol or other drugs; or
- One or more of the vehicles was required to be towed away.

Crashes meeting the above criteria were those that were attended by the Police, and Police were therefore able to notify the RTA of the crash.

In the study more than two hundred (n=205) drivers of prime movers with trailers were involved in crashes and were not wearing a seat belt, while 20 were wearing a seat belt. Of those wearing a seat belt none were killed or seriously injured, and 30% had minor injuries. For those who were not wearing a seat belt, however, 45% were killed or injured (see Table 1).

Table 1. Seat belt use, injury levels and vehicle type

	Large rigid (no trailer)	%	Prime mover and trailer	%
Seat belt not worn				
Fatality	3	3%	6	3%
Serious injury	10	8%	15	7%
Minor injury	32	27%	72	35%
No injury	75	63%	112	55%
Total	120	100%	205	100%
Seat belt worn				
Fatality	0	0%	0	0%
Serious injury	0	0%	0	0%
Minor injury	10	23%	6	30%
No injury	33	77%	14	70%
Total	43	100%	20	100%

The study also included 120 drivers of heavy rigid trucks who were not wearing a seat belt, and 43 who were wearing a seat belt. Of those wearing a seat belt none were killed or seriously injured, 23% had minor injuries and 77% had no reported injuries. For those who were not wearing a seat belt 38% were killed or injured.

These results point to the effectiveness of seat belts in preventing serious and fatal injuries, although they are less effective in preventing minor injuries. These results are consistent with the results from light vehicle crash studies and heavy vehicle crash studies (see below).

Literature Search

The research commissioned by the RTA also looked at past studies that had investigated the effectiveness of seat belts for heavy truck drivers.

These studies, both crash tests, crash simulations and crash investigations all pointed to seat belts providing crash protection for heavy vehicle drivers. Many of the studies took into account the type of crash and the survivability of the cabin space.

Ruter and Hontik (1979) crash tested 5 types of seat belt systems on rigid or air ride seats using Hybrid II dummies in a sled mounted truck cab. Unrestrained dummies contacted with their abdomen against the steering wheel, the chest then colliding with the top of the steering wheel and the head against the windscreen and dashboard. The use of a seat mounted lap sash seat belt, however, prevented critical loads and accelerations on the dummy.

Clarke and Leasure (1986) cite the work of another group, Rice and Shoemaker (1981) who found that a lap belt prevented the dummy from contacting the internal surface in a frontal test, while in a roll-over test it prevented contact with the windshield as had been observed for a non-restrained dummy.

A number of field studies have attempted to quantify the safety value of seat belts for truck drivers, with the estimated safety value of seat belts varying considerably. Using two different methods, Campbell and Sullivan, (1991) estimated, that between 27% and 77% of truck driver fatalities could be prevented by seat belt use. Another study estimated that over 55% of drivers incurring AIS 3+ injuries would have a reduced level of injury had they worn seat belts (Ranney, 1982) based on accident reconstructions.

Conclusion

While the estimates vary, it is clear that seat belt use can prevent death and injury for truck drivers in a crash.

Based on the research reviewed and the results of the NSW Crashed Vehicles Study somewhere between 27% and 77% of truck driver fatalities could be prevented by seat belt use. Based on the overall range of results of the studies reviewed, a general estimate of around 40% to 50% reduction in fatalities could be expected from seat belt use at a similar level to that for light vehicle drivers in New South Wales.

Seat Belt Wearing Rates

It is apparent from crash statistics that a similar increase in seat belt use as occurred in light vehicles has not yet occurred for truck occupants. An observational survey of seat belt wearing by heavy truck occupants and bus drivers was therefore undertaken in early 2002 to:

- Determine the availability and use of seat belts;
- Assist with targeting future seat belt use campaigns; and
- Assist with evaluating the outcome of any campaigns.

Developing an appropriate research method for a seat belt observational survey for heavy vehicles is more difficult than for light vehicles because:

- The height and configuration of many of the heavy vehicle cabins makes it difficult to see if a lap/sash seat belt is available if it is not being worn;
- The Australia Design Rules require only the fitment of a lap belts to these vehicles, and the use and availability of lap only belts is extremely difficult to observe from outside the vehicle.

A literature search revealed very few studies where seat belt use was directly observed for heavy vehicles. A 1995 study for Austroads (Haworth, Bowland, Foddy and Elliott, 1995) observed seat belt use in heavy vehicles from overhead bridges in Melbourne, Australia. One acknowledged limitation of the method used in the study was that it could only be used in urban areas where there was an overhead bridge.

Trialing of this method in Sydney revealed that the heavy vehicles passed so quickly below the overhead bridges that even when using two observers the seat belt use could not be determined.

As an alternative method, trialling of road-side observations found that if the vehicles were travelling slowly enough (ie around 50Km/hr or less) it could be determined if a lap/sash seat belt was being worn. If a lap/sash seat belt was not worn for many vehicles, except prime movers and heavy buses, it could be seen whether a lap/sash seat belt was available.

After piloting, a two part research method was decided upon. The first part of the research used road side observations to gather information on vehicle type and seat belt type and use. The second part of the research involved interviewing heavy vehicle drivers as they pulled in to Heavy Vehicle Checking Stations on major highways, and asking them what type of seat belts were fitted to their vehicle.

The accepted shortcoming of this research method is that lap belt usage can not be observed, however, no effective alternative method was available that

could observe lap belt use. While in the second part of the research occupants were asked if they were wearing the seat belt, self-reported seat belt use always over estimates actual wearing rates. Also, because drivers communicate via CB radio it is likely the seat belt use would increase as a result of the study itself where drivers are being interviewed.

Research Method

Two observers observed each heavy vehicle. Each observation period was for 2 hours. The observers observed the same vehicle and determined:

- What type of heavy vehicle it was;
- Whether each of the occupants was wearing a seat belt; and
- If not, was there is a seat belt available (ie could the buckle be seen on the pillar/seat?).

Observations were undertaken at the roadside (ie standing on the footpath) or in RTA Heavy Vehicle Checking Stations. Observations at the roadside were done where heavy vehicles were travelling slowly or stopped at traffic lights. Every heavy vehicle in the adjacent lane to the observers (or middle lane if there were parked vehicles) was observed. Heavy vehicles in outer lanes were not observed.

For a sample of vehicles at RTA Heavy Vehicle Checking Stations, the driver was approached and asked what type of seat belt was fitted. If the type of belt could be observed the vehicle was not approached.

The type of vehicles observed were:

- Light/medium rigid trucks – Trucks with a gross vehicle mass (GVM) of 4.5 tonne or more, with 2 axels;
- Heavy rigid truck – A truck with three or more axels and GVM of more than 8 tonne;
- Articulated trucks – Primer mover and trailer, including articulated tankers, B doubles and road trains;
- Coaches and route buses – interstate style coaches and State Transit Authority or private route buses; and
- Other buses – any bus not covered by the above which seats 9 or more people.

Research Results

In total 1,488 vehicles were observed in Part 1 of the research and 76 vehicles were observed in Part 2.

Most vehicles observed were either articulated trucks (45%) or light/medium rigid trucks (34%). Very few trucks had passengers (9%) therefore the vast majority (91%) of occupants observed were drivers.

The research found that the light/medium rigid trucks had the highest proportion of lap/sash belts, with around 85% of drivers having a lap/sash seat belt. For larger trucks a high proportion of drivers had a lap only belt available (eg around 50% of articulated truck drivers). Very few seating positions and vehicles had no seat belt fitted (only 2% of articulated trucks).

The figures presented are based on observed use of seat belts in Part 1 of the Research. Where the seat belt could not be seen, the type of belt available has been estimated based on the information from Part 2 of the research.

Overall only 33% of truck occupants were wearing a lap/sash seat belt (see Table 2). 32% of truck drivers were wearing a lap sash seat belt, the seat belt that will provide them with the greatest degree of protection in a crash. An estimated further 30% of drivers had a lap/sash seat belt available that they could have been wearing, and weren't doing so.

An estimated 37% of drivers had a lap belt available, although the level of use is not known.

Table 2. Seat belt use in all trucks – NSW total

	Driver	Outside Passenger	Centre Passenger	Total
Lap/Sash Worn	435	61	0	496
<i>% of total</i>	32%	52%	0%	33%
Lap/Sash Not Worn	405	43	0	448
<i>% of total</i>	30%	37%	0%	30%
Lap Worn	1	1	0	2
<i>% of total</i>	0%	1%	0%	0%
Lap Not Worn	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Lap Unknown Use	503	12	18	533
<i>% of total</i>	37%	10%	75%	36%
Belt Type Unknown	0	0	6	6
<i>% of total</i>	0%	0%	25%	0%
No Belt Fitted	13	0	0	13
<i>% of total</i>	1%	0%	0%	1%
Total	1357	117	24	1498
<i>% of total</i>	100%	100%	100%	100%

Only 12% of bus drivers were wearing a lap/sash belt, and an estimated further 5% had a lap/sash belt but were not using it (see Table 3). In total an estimated 81% of bus drivers had a lap only belt available to them for use.

Table 3. Seat belt use by bus drivers – NSW total

Type of Belt	Driver	%
Lap/Sash Worn	15	12%
Lap/Sash Not Worn	6	5%
Lap Worn	12	9%
Lap Not Worn	0	0%
Lap Unknown Use	93	72%
Belt Type Unk	4	3%
No Belt Fitted	0	0%
Total	130	100%

Light/Medium Rigid Trucks

Examining each vehicle group separately, light/medium rigid trucks had the highest level of lap/sash seat belt use, with 55% of drivers and 61% of outside passengers wearing a lap/sash seat belt (see Table 4). Overall an estimated 30% of light/medium rigid truck occupants were not wearing an available lap/sash belt. An estimated 16% had a lap only belt.

Table 4. Seat Belt use in light/medium rigid trucks

	Driver	Outside Passenger	Centre Passenger	Total
Lap/Sash Worn	279	53	0	332
<i>% of total</i>	55%	61%	0%	55%
Lap/Sash Not Worn	147	33	0	180
<i>% of total</i>	29%	38%	0%	30%
Lap Worn	1	1	0	2
<i>% of total</i>	0%	1%	0%	0%
Lap Not Worn	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Lap Unknown Use	77	0	18	95
<i>% of total</i>	15%	0%	100%	16%
Belt Type Unk	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
No Belt Fitted	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Total	504	87	18	609
<i>% of total</i>	100%	100%	100%	100%

The safety benefits from seat belt use by heavy truck occupants

Heavy Rigid Trucks

Only 25% of heavy rigid truck drivers were wearing a lap/sash seat belt, while an estimated 32% were not wearing an available lap/sash seat belt. An estimated 43% had a lap belt (see Table 5).

Table 5. Seat belt use in heavy rigid trucks

	Driver	Outside Passenger	Centre Passenger	Total
Lap/Sash Worn	45	3	0	48
<i>% of total</i>	25%	27%	0%	24%
Lap/Sash Not Worn	58	1	0	59
<i>% of total</i>	32%	9%	0%	30%
Lap Worn	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Lap Not Worn	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Lap Unknown Use	78	7	0	85
<i>% of total</i>	43%	64%	0%	43%
Belt Type Unk	0	0	4	4
<i>% of total</i>	0%	0%	100%	2%
No Belt Fitted	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Total	181	11	4	196
<i>% of total</i>	100%	100%	100%	100%

Articulated Trucks

Articulated trucks have the lowest level of lap/sash seat belt use (see Table 6). Only 17% of drivers were wearing a lap/sash belt, with an estimated 30% not wearing an available lap/sash belt. Over half had a lap only belt.

Table 6. Seat belt use in articulated trucks

	Driver	Outside Passenger	Centre Passenger	Total
Lap/Sash Worn	111	5	0	116
<i>% of total</i>	17%	26%	0%	17%
Lap/Sash Not Worn	199	9	0	208
<i>% of total</i>	30%	47%	0%	30%
Lap Worn	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Lap Not Worn	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
Lap Unknown Use	349	5	0	354
<i>% of total</i>	52%	26%	0%	51%
Belt Type Unknown	0	0	0	0
<i>% of total</i>	0%	0%	0%	0%
No Belt Fitted	13	0	2	15
<i>% of total</i>	2%	0%	100%	2%
Total	672	19	2	693
<i>% of total</i>	100%	100%	100%	100%

Conclusion

It is important that almost all heavy truck occupants and bus drivers had a seat belt available for them to use. The high proportion of lap only belts is of concern, however, because:

- A lap only belt, while providing protection in a crash, may not be as effective in preventing injuries as a lap/sash seat belt;
- Enforcement of lap belts is difficult because their use is difficult to observe from outside the vehicle. Research in Australia and the USA has shown that where there is seat belt enforcement wearing rates are consistently higher than where there is no enforcement.

The availability and use of lap/sash seat belts is low compared to light vehicles, and the level of use decreases as the trucks increase in size, with availability and use being lowest for articulated trucks.

Overall Conclusion

While the wearing rates indicate that many truck drivers in NSW do not currently wear seat belts, the reasons raised in objection to seat belt use by those interviewed are either incorrect (eg “they’re dangerous”) or easily overcome (eg improving comfort by changing the type of seat belt).

The value of seat belts in saving lives and preventing injuries has been demonstrated by many studies. While the estimated effectiveness varies, all the studies point to the use of a seat belt being safer than being unrestrained in a crash.

The observational survey of seat belt use, however, shows that many drivers and passengers are putting themselves unnecessarily in danger by not using an available seat belt.

Overall therefore these results point to the need to improve seat belt use by truck occupants, and that this increased use would result in saving up to an estimate of 10 lives per year in NSW.

The experience from light vehicles in Australia and overseas is that high levels of seat belt use is achieved when:

- Seat belts are available to use;
- People are provided with information on the safety value of seat belt use;
- Seat belt use is enforced (Freedman, Wood and Henderson, 1974)

A number of strategies could therefore be put in place to improve seat belt wearing rates for truck occupants. These include:

- Informing drivers and operators of the safety value of using seat belts in trucks, and addressing the false beliefs that it is better to be unrestrained in a crash
- Encouraging truck owners to provide vehicles with appropriate restraints fitted so that drivers can use them easily and comfortably;
- Informing drivers about the legal requirement to wear an available seat belt;
- Enforcing the seat belt regulations, keeping in mind the above stated difficulties with lap only belts.

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