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# TRAFFIC ACCIDENT RESEARCH UNIT



## CARAVANS IN TRAFFIC CRASHES

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RODNEY G. VAUGHAN  
B.E. (Hons), M. Eng. Sc.

DEPARTMENT OF MOTOR TRANSPORT NEW SOUTH WALES

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The Traffic Accident Research Unit was established within the Department of Motor Transport, New South Wales, in May 1969 to provide a scientific approach to the traffic accident problem.

This paper is one of a number which report the results of research work undertaken by the Unit's team of medical, statistical, engineering and other scientists and is published for the information of all those interested in the prevention of traffic accidents and the amelioration of their effects.

*A. H. Coleman*

Commissioner.



# CARAVANS IN TRAFFIC CRASHES

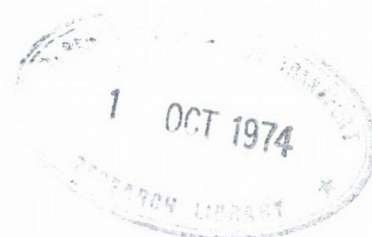


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**RODNEY G. VAUGHAN**  
**B.E. (Hons), M. Eng. Sc.**

**TRAFFIC ACCIDENT RESEARCH UNIT,  
DEPARTMENT OF MOTOR TRANSPORT,  
NEW SOUTH WALES.**

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## Caravans in Traffic Crashes

From time-to-time, questions arise regarding the role played in traffic crashes by caravans towed by cars or car-derived vehicles (station waggon, utilities, panel vans). It has been suggested that towed caravans may constitute an undue hazard to other road users and that therefore special restrictions should be placed on usage of these vehicles. Such restrictions may, for example, be in the form of special licensing requirements, vehicle/caravan combination design requirements or speed limits. This paper sets out to examine the involvement of towed caravans in traffic crashes in New South Wales and to consider variously proposed countermeasures.

### Overall involvement in crashes.

For the purposes of this paper, reported traffic crashes which occurred during the year ended 30th June, 1973 were analysed. Of the 117,206 crashes and 28,497 casualty crashes which were reported during this period, 405 (0.35%) and 52 (0.18%), respectively, directly involved\* caravans towed by cars or similar vehicles (this is irrespective of whether or not the reporting Police officers had judged the vehicles towing the caravans to be "responsible" for the crashes). A total of 1,181 persons were killed and 38,301 persons were injured in all reported traffic crashes during these 12 months: six (0.51%) of the persons killed and 72 (0.19%) of the persons injured were casualties in crashes directly involving caravans. Caravan-involved crashes tend to be spectacular and may be more likely to be reported than the "average" crash.

It is clear from the above figures that crashes directly involving caravans did not constitute a very large proportion of the overall traffic crash problem during the period studied.

\* direct involvement of a vehicle in a crash means that it collided with another vehicle, a pedestrian or an object (including rollover).



Fatalities.

The six fatalities mentioned in the above section occurred in five separate crashes. The following is a brief description of the circumstances of these crashes.

Fatal crash No. 1

The two persons killed in this crash were the driver and front seat passenger in a station waggon which was towing a caravan on the open road. The fatalities resulted from a rear-end collision when the station waggon impacted a parked semi-trailer.

Fatal crash No. 2

The deceased was a passenger in a car which travelled on to the incorrect side of the roadway and collided head-on with a second car towing a caravan. As a result of the collision, the caravan disintegrated and a piece of wooden framework from the van entered the first car, striking the deceased in the head.

Fatal crash No. 3

The deceased was a passenger in a utility which was being towed by another vehicle. These two vehicles were overtaking a car and caravan combination when the towed utility collided with the caravan and the utility driver subsequently lost control of the vehicle.

Fatal crash No. 4

The deceased was a motor cycle rider who lost control of his machine and ran into the path of a station waggon towing a caravan.

Fatal crash No. 5

The deceased was the driver of a car which crossed to the incorrect side of the road and crashed head-on with a car towing a caravan.

It can be seen from the above that in the last two of the five fatal crashes, the fact that a vehicle towing a caravan was involved appeared largely incidental.

#### Indirect involvement of caravans in crashes.

It has been suggested that towed caravans indirectly "cause" traffic crashes when, for example, following vehicles overtake a car-caravan combination. In order to test this hypothesis, the Police accident reports for all traffic crash fatalities which occurred in the two years ending 30th June, 1973 were examined. A total of 2,318 persons were killed in traffic crashes during this period, but no reference could be found to the indirect involvement of towed caravans in these fatal crashes.

#### Trends in traffic crash involvement.

In order to determine whether the crash involvement of caravans is stable or otherwise, the involvement statistics of car-caravan combinations in crashes were examined over the period 1968 to 1973 inclusive. The results of this examination are given in Table 1.

It can be seen that the rates for involvement of car-caravan combinations in accidents, casualty accidents and resulting casualties, whilst fluctuating from quarter-to-quarter, do not appear to have changed drastically over the 5½ year period studied.

#### Time of involvement.

In order to ascertain whether crashes involving towed caravans occurred to systematic time patterns, the time-of-day, day-of-week and month-of-year patterns of the 405 crashes studied in detail were analysed (Tables 2, 3 and 4). The bulk of caravan-involved crashes occurred from mid-morning through to late afternoon and the majority tended to occur late in the week or early on the weekend. The month-of-year table tends to show peaks in the major holiday periods (December-January, April-May-June and August-September-October), as might be expected.



Driving experience of involved drivers.

The "driving experience" (in terms of years holding a driver's licence) of the drivers of cars and similar vehicles towing caravans in the 405 crashes was examined (Table 5). There were no learner-drivers involved and only 4 (1%) drivers with less than one year's driving experience involved. A total of 81% of involved drivers had 10 or more years driving experience: a census of Class 1 licence holders in New South Wales in December 1971<sup>2</sup> showed that only 45% of licensed drivers had 10 or more years driving experience (a Class 1 licence entitles one to drive cars and car-type vehicles).

Thus it can be seen that the bulk of drivers involved in crashes whilst driving vehicles towing caravans were not newly-licensed drivers. The high involvement of "experienced" drivers is presumably largely because they also constitute the bulk of drivers of vehicles towing caravans - no data are available on this.

It has been suggested from time-to-time that learner drivers and provisional licence holders should not be permitted to drive vehicles towing caravans. At the present time, there are no such restrictions in New South Wales.

Their crash involvement does not appear to justify additionally restricting learner-drivers or provisional drivers in the driving of vehicles towing caravans.

Age of drivers involved.

The ages of drivers towing caravans involved in the 405 crashes studied were examined (Table 6). A total of 81% of involved drivers were 30 or more years of age: the December 1971 licence census<sup>2</sup> indicated that 62% of New South Wales Class 1 licence holders were 30 or more years of age. Once again, the high involvement of older drivers is presumably largely because older drivers also constitute the bulk of drivers of vehicles towing caravans - no data could be found on this.

Sex of drivers involved.

The sex of drivers of vehicles towing caravans involved in the 405 crashes was studied (Table 7). Approximately 89% of involved drivers were male, 10% female and in 1% of cases the sex of the driver could not be determined from the Police accident report form. The reason for the dominant position of the male drivers is not known for certain, but presumably it is that caravans are usually towed when families are going on holidays and it is probably normal practice for the husband to drive the vehicle most of the time. Again, no data are available.

Speed limit applying to the roads.

The speed limits applying to the roads where the 405 caravan-involved crashes occurred were examined (Table 8). About one-fifth of the crashes occurred on roads subject to the built-up area speed limit of 35 mph. A total of 59% of crashes occurred on roads subject to speed limits of 50 mph or less and 15% occurred on roads subject to speed limits of over 50 mph. About one quarter of the crashes occurred on roads subject to the prima facie speed limit of 50 mph (a prima facie speed limit permits a driver to exceed the posted limit, but if apprehended and prosecuted he must furnish proof that conditions at the time were such that it was in fact safe for him to do so).

Five of the six fatalities occurred where the speed limit was 50 mph or less, and the sixth fatality occurred on a road with a prima facie limit.

Measured speeds of vehicles towing caravans.

In order to obtain some estimate of the actual speeds vehicles towing caravans achieve on highways, speed surveys were carried out using a radar speed meter. The surveys were carried out in January 1974 on the Pacific Highway at Ourimbah where the roadway consisted of a long straight four lane carriageway with a level surface and where the absolute speed limit applying was 55 mph. Two surveys were



carried out - the first in steady rain with moderate-to-heavy traffic and second when the sky was overcast, but fine, and the traffic was light. In the first case, 142 vehicles towing caravans were observed with a mean speed of 37 mph and a standard deviation of 5 mph. In the second case, 112 vehicles were observed having a mean speed of 42 mph and a standard deviation of 4½ mph. A detailed breakdown of the observed speeds is given in Table 9.

As might be expected, the combination of fine weather and lighter traffic led to the vehicles towing caravans in the second case to travel somewhat faster than in the first case. At the present time, the New South Wales law requires that the speeds of vehicles towing caravans weighing more than 15 cwt must not exceed 45 mph. Although the observers who carried out the speed survey could not, of course, know precisely the weights of the caravans passing them, the general observation of the sizes of the caravans involved indicates that most (if not all) of them would have exceeded the 15 cwt limit nominated. Thus, probably few of these combinations should have been travelling at greater than 45 mph. In the first group of caravans, that is, those travelling in the moderate-to-heavy traffic and wet weather, only two (1½%) exceeded the special 45 mph limit whereas in the second case, 20 (18%) exceeded the special 45 mph limit.

With the adoption of the metric system, it has been suggested that particular vehicle types (such as semi-trailers and towed caravans) currently restricted to speeds of 45 mph should be permitted to travel at 80 km/h (50 mph). Part of the rationale for this suggestion is that it is well established that increasing the spread of speeds in a traffic stream increases the crash potential of that traffic stream<sup>1</sup>.

The speed surveys (Table 9) indicated a wide spread of towed caravan speeds on the open road and also that the drivers of the vehicles towing caravans adjusted their speeds according to the prevailing conditions. It is apparent from the speed measurement data that, even under identical conditions, drivers of vehicles towing

caravans travelled at widely varying speeds - individuals apparently drove at speeds which they found suited themselves and their vehicles. It seems possible that highway speed limits are largely irrelevant to most drivers of vehicles towing caravans - other factors decide the speeds at which they choose to travel.

Stated speeds of involved caravans.

Police officers investigating traffic crashes attempt to ascertain (as best they can) the estimated speeds of the involved vehicles immediately prior to the crash. These stated speeds for vehicles towing caravans in the 405 crashes have been analysed (Table 10).

There were 21 cases out of the 405 examined where the Police stated that the estimated speed prior to the crash exceeded 45 mph (these included one fatal crash where two persons were killed). In nine of these cases the caravans' unladen weights exceeded 15 cwt, in five cases their unladen weights were less than 15 cwt and in seven of these cases the unladen weights of the caravans could not be determined.

The mean stated speed of the motor vehicles towing caravans in the 379 crashes where a speed was nominated was 31 mph and the standard deviation was 12 mph. This contrasts sharply with actual, observed values found by radar speed meter measurements as listed in the preceding section. The mean stated speed is well below the measured speeds and the spread of stated speeds is much wider. The differences may well be accounted for by the fact that the crashes occurred at a large variety of locations - open roads, suburban streets and so on - whereas the speed measurements were all taken at one location on a good quality, open road. Another possible reason for the mean stated speed being lower than the mean measured speed is that the drivers of vehicles towing caravans may have slowed down in an attempt to avoid crashing.

The stated speeds were examined for the vehicles towing caravans in the 291 crashes where the speed limit applying was 50 mph or



greater. The mean stated speed of the 276 crashes where a speed was nominated was 34.7 mph with a standard deviation of 10.7 mph. This mean speed was still well below the two measured mean speeds of vehicles towing caravans on "the open road" and the spread of stated speeds was again wider than the measured spread. The reasons for this are not certain, but it seems probable that some stated speeds are well under the actual speeds of the vehicles in the crashes, whereas other reported speeds are probably reasonably accurate. This would account for the lower mean and greater spread.

There were 21 crashes (5%) where the stated speed immediately prior to the crash was greater than 45 mph and 251 (62%) where the stated speed was between 25 mph and 45 mph. Because the spread of stated speeds was very wide, and in view of the characteristics of measured speeds of caravans on the open road, it seems doubtful whether the upper range of stated speeds would be markedly different in the event of the 45 mph speed limit for towed caravans being raised.

#### Crash classifications and vehicle manoeuvres.

As a first step in studying the 405 crashes involving caravans, the crashes were classified into various broad groupings that briefly give an overall description of the crash-type (Table 11). Other factors which played a part in the crashes are further examined in the next section.

The largest single characteristic of caravan-involved crashes was overturning without leaving the roadway - this was the case in nearly one-quarter of the crashes studied. The next largest type of crash was the opposite-direction side-swipe and head-on collision - these resulted in 17% of the reported crashes. Of these crashes, 8% involved a vehicle other than the vehicle towing the caravan being on the incorrect side of the road and 4% involved the vehicle towing the caravan being on the incorrect side of the road. In the remainder of the cases, it could not be determined which vehicle was on the correct side of the road.

In 13.3% of the cases, the collisions consisted of side-swipes with other vehicles going in the same direction (this indicates the difficulties which can arise when other vehicles overtake, or are overtaken by vehicles towing caravans). Rear-end collisions took place in 13.1% of cases: in 10.1% of these cases another vehicle ran into the rear of the caravan, in 2.7% the vehicle towing the caravan ran into another vehicle and in 0.2% of the cases the situation could not be determined from the Police accident report forms. The next most serious form of crash involving caravans was that involving the vehicle running off the road - this occurred in 10.9% of reported crashes. Jack-knifing was also a problem with caravans - this occurred in 6.7% of the crashes studied. Collisions with fixed objects on the road and right angle intersection accidents also featured in the study - 4.4% and 4.0%, respectively, were collisions of these types. Other collision types accounted for the remaining 8.4%.

#### Other characteristics of caravan crashes.

The preceding section contains the broad classification of accident types involving towed caravans. However, as in other traffic crashes, caravan crashes involved other factors as well. The principal ones of interest arising from the study of the 405 crashes concern the stability of car-caravan combinations and mechanical failures. Information on these two factors was extracted from the Police accident report forms and collated. One should recognise the limitations of such data, in that not all of the factors in a crash are necessarily known to the investigating Police officers and, even when known, may not be reported on the (necessarily limited) report form. In addition, it can be extremely difficult after a crash to determine whether a vehicle component that is in a damaged or defective condition was a contributing factor or a result of a crash.

With these limitations in view, the following factors were extracted from the Police accident reports. Where one factor was associated with another, the crash was entered under both



classifications - for example, where a car-caravan combination jack-knifed and overturned, it was listed both under

"jack-knifed and overturned" and also under

"overturned (jack-knifed and .....)"

The various factors are listed in Table 12.

In 174 (43%) of the 405 crashes involving towed caravans, the stability of the vehicle/caravan combination may have been a factor in the crash (either in the pre-crash or crash phase of the collision). In many of these crashes, more than one stability factor appeared.

Over a quarter (28%) of the crashes involved the caravan overturning and in a quarter of these cases, the overturning was associated with mechanical failure. Wind gusts were mentioned in 7½% of the crashes, including 1% where the gust was associated with an overtaking or passing vehicle. Jack-knifing occurred in 7% of the crashes. "Loss of control" under various circumstances was also mentioned in 7½% of cases.

Mechanical failures were associated with 50 (12½%) of the crashes. Tyre failures featured in 19 crashes; coupling failures of various types in 13 crashes; wheel, axle and suspension failures in 10 crashes; and brake defects or failures in 8 crashes.

#### Vehicle types towing caravans.

The towing vehicles in the 405 crashes studied were examined (Table 13). By far the bulk of the vehicles involved were cars (64%), with station waggons (12%) and utilities (9%) next in number. In 9% of cases, the vehicle type could not be determined from the Police accident report form.

An analysis of the types of vehicles towing caravans observed during the speed measurements at Ourimbah in January, 1974 has been undertaken (Table 14). Again in this case, cars were the dominant towing vehicle.

Origin of involved vehicles.

A high percentage of the vehicle-caravan combinations involved in the 405 crashes studied were not registered in New South Wales: 123 (30%) involved vehicles not registered in New South Wales and 240 (59%) involved New South Wales-registered vehicles. The source of registration of the remaining 42 vehicles could not be determined from the Police accident reports.

No data are available on the extent of usage, in terms of miles travelled, of caravan/towing vehicle combinations in New South Wales, whether registered in New South Wales or elsewhere.

Weight ratios of involved caravans and towing vehicles.

One of the requirements for towed vehicles in New South Wales is that (in effect) the laden weight of a trailer or caravan must not exceed the unladen weight of the towing vehicle. The laden weights of the caravans involved in the 405 crashes could not be obtained, since this information is not normally gathered. However, in 273 crashes (two-thirds of the crashes studied), the unladen weights of the caravans and the towing vehicles could be ascertained from the various registering authorities.

The ratios of the unladen weights of the various caravan/towing vehicle combinations were calculated and collated (Table 15). It is clear that where the ratio of unladen caravan weight to unladen towing vehicle weight equalled or exceeded unity, the New South Wales towing requirements would not have been met. Because some allowance would have to be made for loading in the caravans, it is also probable that where the unladen weights ratio was close to unity, loading in the caravan concerned would have meant that the towing requirements would not have been met.

There were 14 (5% of the available weight ratios) cases where the weight ratio equalled or exceeded unity and 45 (16%) where the weight ratio equalled or exceeded 0.8. As there are no data on the weight ratios of caravans and towing vehicles in normal use, it is not possible to state whether or not those combinations breaching the New South Wales weights ratio towing requirement were over-represented in the crashes studied.



### Other research into caravan safety

A limited number of published reports on research into caravan safety were located by the author <sup>3,4,5,6,7,8</sup>. The dominant theme in most of these reports is the question of towing vehicle/caravan stability.

The item commonly mentioned first in this area is the longitudinal location of the caravan centre of gravity (C.G.) and its effect on the loading at the towing coupling. Most of the authors <sup>3,4,7</sup> agreed that it is desirable for the downward coupling load of the caravan to be about 10% of the caravan weight. However, Korn <sup>5</sup> believes that the load should be 12-15% of the caravan weight.

If the caravan C.G. is too far to the rear, then a horizontal oscillatory motion known as "snaking" or "tailwagging" can be set up. To some extent, this can be countered by damping of movement at the caravan coupling. If, on the other hand, the C.G. is too far forward, the excessive load on the trailer coupling tends to lift the towing vehicle's front wheels, steering becomes difficult and excessive understeer can take place. A further disability in this situation is that minor irregularities in the road surface can further adversely affect the steering ability of the combination.

Another problem connected with the location of the caravan C.G. is the rear overhang of the towing vehicle - that is, the distance from the towing vehicle's rear axle to the caravan coupling. Vertical coupling loads assume greater importance as the rear overhang increases. However, this problem can be eased by the fitting of load equalisers which distribute the coupling load more evenly over the front and rear wheels of the towing vehicle and the caravan's wheels. It should be noted that the simple fitting of heavier duty and/or overload springs to the rear axle of the towing vehicle, without use of load equalisers, will not adequately compensate for a very high coupling load. Although such an approach may tend to keep the towing vehicle level, it will not prevent the reduction of load on the steering tyres and can severely adversely affect the vehicle's handling when not towing a caravan <sup>3,4</sup>. Figures 1 and 2 illustrate the operation of overload springs and load equalising couplings.

The moment of inertia of a caravan also effects its tendency to "snake" - a larger moment of inertia increasing the tendency. However, for many practical reasons, this can be difficult to control.

Beerman <sup>6</sup> found that the ratio of trailer (including caravans) mass to towing vehicle mass had little effect on "snaking" if the tyre side-force coefficient of the caravan tyres matched the caravan's weight. He also found that draw-bar length appeared to have little effect on snaking. His major recommendation in this area was that caravan tyre side-force coefficients should be increased by, for example, fitting larger tyres. The additional fitting of larger tyres to the towing vehicle's rear axle has also been recommended by Beerman <sup>6</sup> and O'Brien <sup>4</sup> to assist in countering this problem.

One widely recommended feature, which is clearly supported by engineering principles, is that the centres of gravity of caravans should be as low as possible to reduce roll and any tendency to overturn. For the same reason, "live" or moving loads should be minimised.

Wojcik and Mellinger <sup>7</sup> have reported on preliminary work for a project which included an extensive study of the problem of caravan safety (their final report was not available when this report was written). In one analysis of 130 crashes involving towed caravans, they found that in half of them, it was reported that the caravan developed "snaking" prior to the crash. In over a third of the cases, the caravan overturned during the crash. Other prominent factors that were rated as causal by Wojcik and Mellinger in the crashes which they studied were mechanical failures and "external factors", such as wind.

#### Restriction on towed caravans.

Restrictions affecting towed caravans in the States and Territories of Australia have been examined from documents available at the Traffic Accident Research Unit. Some information from Britain and the consensus of information on requirements in the individual States of the USA were also examined. A summary is given in Table 16.



Most legislation has a general requirement to the effect that the weight of a trailer (including any caravan) and its loading must not be such as to interfere with the proper control of the trailer/towing vehicle combination. In New South Wales and Tasmania, the laden weight of a caravan must not exceed the unladen weight of the towing car, station waggon or utility. This weights ratio restriction also applies in Western Australia for caravans not fitted with brakes, but where caravan brakes are fitted, the caravan laden weight may be up to  $1\frac{1}{2}$  times the unladen weight of the towing vehicle. In Queensland, the laden weight of a caravan fitted with "override" brakes must not exceed the unladen weight of the towing vehicle. Other weight ratio restrictions found are clearly aimed at large commercial vehicles and semi-trailers.

As far as could be ascertained, only Victoria prohibits "Learner" drivers from towing caravans. Where specific speed limits for caravans were found, they were generally 45 mph, although Britain permits towing at 50 mph. In many Australian States and in the USA, riding in caravans is prohibited.

### Summary

All traffic crashes that occurred during the year ended June, 1973 and that involved caravans towed by cars or similar vehicles were studied (this was irrespective of whether or not the reporting Police officers had judged the vehicles towing the caravans to be "responsible" for the crashes). The following comments and conclusions are based largely on these studies.

- (a) crashes involving caravans constituted 0.35% of the total and 0.18% of all casualty crashes, involving 0.51% of traffic crash fatalities and 0.19% of traffic crash non-fatal casualties, during the period studied.
- (b) in two of the five fatal crashes studied, the fact that a vehicle towing a caravan was involved appeared to be largely incidental.
- (c) a study of Police accident reports for all fatal traffic crashes during the two-year period ended 30th June, 1973 failed to locate any reference to the indirect involvement of a caravan in a crash.
- (d) although there were fluctuations from quarter-to-quarter, no marked changes in the involvement of car-towed caravans in traffic crashes over the last 5½ years appeared to have occurred.
- (e) caravan-involved crashes tended to occur more in the mid-morning through to late afternoon; late in the week or early in the weekend; and in the months of the year with the major holiday periods.
- (f) the bulk of drivers of vehicles towing caravans involved in the crashes studied were not newly-licensed drivers - 81% had 10 or more years driving experience. No learner-drivers and 4 (1%) drivers with less than 1 year driving experience were involved. Their crash involvement



does not appear to justify additionally restricting learner-drivers and provisional drivers in the driving of vehicles towing caravans.

- (g) approximately 89% of drivers of vehicles towing caravans involved in the crashes studied were 30 or more years of age.
- (h) approximately 89% of the involved drivers of vehicles towing caravans were male and 10% were female. In 1% of cases the sex of the driver could not be determined from the Police accident report form.
- (i) about three-quarters of the crashes occurred on roads subject to the prima facie speed limit of 50 mph or to absolute speed limits of 50 mph or less.
- (j) under apparently good conditions, a large proportion of vehicles towing caravans exceeded the open road limit for most caravans of 45 mph.
- (k) the mean stated speed of the vehicles towing caravans in the crashes studied was much lower than measured speeds on the open road.
- (l) the largest single characteristic of caravan-involved crashes was overturning without leaving the roadway - this was the case in nearly one quarter of the crashes studied. The next most common types of crashes were the opposite direction side-swipe and head-on collisions, and side-swipes with vehicles going in the same direction.
- (m) in almost half of the crashes involving towed caravans that were studied, the stability of the caravan/towing vehicle combination appeared to have been a factor in the crash (either in the pre-crash or the crash phase of the collision).

- (n) the bulk of the vehicles towing caravans that were involved in the crashes studied were motor cars, followed by station waggon and utilities.
- (o) nearly one third of the caravan/towing vehicle combinations involved in the crashes studied were not registered in New South Wales.
- (p) about 15% of the caravan/towing vehicle combinations involved in the crashes studied appeared not to have met the requirement for towed vehicles in New South Wales that the laden weight of the trailer or caravan must not exceed the unladen weight of the towing vehicle.
- (q) it is desirable for the coupling vertical load to equal about 10-15% of the weight of the caravan concerned. If the centre of gravity of a caravan is too far rearward, "snaking" can occur, whereas if the centre of gravity is too far forward, steering difficulties can arise. Load equalisers and increased tyre sizes on both the caravan and the rear wheels of the towing vehicle can assist in countering these problems. Centres of gravity of caravans should also be kept as low as possible, and moving loads kept to a minimum.

#### Recommendations

1. The area most likely to give benefit in reduction of the losses arising from crashes involving towed caravans is the stability of the caravan/towed vehicle combinations. More widespread use of load equalisers and larger tyres on caravans and the rear wheels of towing vehicles are likely to assist in this regard. Moving loads should be minimised and the centres of gravity of caravans should be kept low and located in a longitudinal location such that the coupling vertical load is about 10-15% of the caravan weight.



2. There is no evidence that the present 45 mph speed limit in New South Wales for towed caravans exceeding 15 cwt in weight affects crash involvement. With the introduction of the Metric system, it has been proposed that the speed limits for other vehicles currently limited to 45 mph will be raised to 80 km/h. Since it is known that increasing the spread of speeds in a traffic stream increases the crash potential of that traffic stream and a large proportion of towed caravans already travel at faster than 45 mph, it is recommended that the speed limit for towed caravans weighing more than 15 cwt also be raised to 80 km/h.

Footnote: On 18th March, 1974 the New South Wales Minister for Transport announced that the speed limit for vehicles towing caravans and trailers weighing more than 15 cwt (762 kg) would be increased to 80 km/h when metric speed limits come into force on July 1, 1974.

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Quarter and Year	Total No. of Crashes	No. of Crashes Involving Caravans	Caravan Crashes & Total Crashes	Total No. of Casualty Crashes	No. of Casualty Crashes Involving Caravans	Caravan Casualty Crashes & Total Casualty Crashes	Total No. of Injuries	No. of Injuries Involving Caravans	Caravan Injuries & Total Injuries	Total No. of Killed	No. of Killed Involving Caravans
Mar. 68	17878	56	0.31	5361	11	0.21	7428	27	0.36	297	1
June 68	19439	49	0.25	5819	14	0.24	7927	22	0.28	284	3
Sept. 68	19215	42	0.22	5674	10	0.18	7504	16	0.21	298	0
Dec. 68	19756	61	0.31	5920	9	0.15	8060	16	0.20	332	2
Mar. 69	17164	48	0.28	4970	12	0.24	6789	18	0.27	243	2
June 69	21907	46	0.21	6522	13	0.20	8767	22	0.25	333	1
Sept. 69	22233	49	0.22	6148	7	0.11	8253	15	0.18	301	0
Dec. 69	23884	54	0.23	6524	8	0.12	8943	16	0.18	311	0
Mar. 70	22070	79	0.36	6159	13	0.21	8698	20	0.23	312	1
June 70	23191	74	0.32	6522	10	0.15	8861	23	0.26	343	0
Sept. 70	23580	65	0.28	6330	7	0.11	8691	17	0.20	301	0
Dec. 70	24157	46	0.19	6423	2	0.03	8636	2	0.02	353	0
Mar. 71	22104	68	0.31	6327	10	0.16	8984	28	0.31	277	0
June 71	23017	48	0.21	5961	11	0.19	8094	18	0.22	333	2
Sept. 71	28180	63	0.22	7936	14	0.18	10769	22	0.20	329	0
Dec. 71	26246	52	0.20	6351	8	0.13	8813	19	0.22	310	5
Mar. 72	26838	84	0.31	6708	8	0.12	9135	11	0.12	218	2
June 72	26207	81	0.31	6386	13	0.20	8530	26	0.30	280	6
Sept. 72	29090	73	0.25	6483	8	0.12	8587	12	0.14	294	1
Dec. 72	31240	80	0.26	7788	13	0.17	10562	22	0.21	300	0
Mar. 73	29620	115	0.39	7532	11	0.15	10243	16	0.16	271	1
June 73	27256	87	0.32	6694	6	0.09	8909	8	0.09	316	1

Table 1: Trends in crashes involving motor cars towing caravans.  
(Note: this does not include station waggon's, utilities, etc. towing caravans.)

Time of Day		No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
After midnight and up to	2 a.m.	2	1	0	2
2 a.m.	4 a.m.	1	0	0	0
4 a.m.	6 a.m.	3	1	0	1
6 a.m.	8 a.m.	15	3	0	3
8 a.m.	10 a.m.	44	4	0	9
10 a.m.	12 noon	77	8	0	14
12 over	2 p.m.	60	6	2	12
2 p.m.	4 p.m.	76	12	0	13
4 p.m.	6 p.m.	64	6	0	8
6 p.m.	8 p.m.	36	7	2	7
8 p.m.	10 p.m.	15	0	0	0
10 p.m.	midnight	11	4	2	3
Not Stated		1	0	0	0
Total		405	52	6	72

Table 2: The times of the day at which the caravan-involved crashes under study occurred.



Day of Week	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
Sunday	50	3	0	3
Monday	40	11	2	16
Tuesday	41	10	0	12
Wednesday	65	6	0	9
Thursday	62	4	2	4
Friday	76	6	1	10
Saturday	71	12	1	18
Total	405	52	6	72

Table 3: The days of the week on which the caravan-involved crashes under study occurred.

Month of Year	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
January	65	7	0	8
February	24	3	0	3
March	21	3	1	6
April	48	8	3	8
May	35	4	1	6
June	35	2	0	3
July	16	1	0	1
August	33	4	1	8
September	42	5	0	8
October	32	7	0	12
November	13	3	0	3
December	41	5	0	6
Total	405	52	6	72

Table 4: The months of the year on which the caravan-involved crashes under study occurred.



Driving experience	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
Learner drivers	0	0	0	0
< 1 years	4	1	0	1
1 - 4 years	20	3	0	6
5 - 9 years	43	5	0	4
10-19 years	113	15	2	23
20-29 years	90	8	2	13
30-39 years	61	6	0	8
40-49 years	51	8	0	11
50+ years	13	2	0	2
Not stated	10	4	2	4
Total Drivers	405	52	6	72

Table 5: The driving experience (in terms of years holding a driving licence) of drivers of vehicles towing caravans in the crashes under study.

Age of Drivers	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
< 20 years	6	2	0	2
20-24 years	27	4	0	4
25-29 years	35	4	0	8
30-39 years	97	14	2	20
40-49 years	85	4	0	5
50-59 years	80	9	4	11
60+ years	68	13	0	20
Not stated	7	2	0	2
Total Drivers	405	52	6	72

Table 6: The ages of drivers of vehicles towing caravans involved in the crashes under study.



Sex of Drivers of Vehicles Towing Caravans	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
Male	361	42	5	58
Female	39	8	1	12
Could not be determined from reports	5	2	0	2
Total drivers	405	52	6	72

Table 7: The sex of drivers of vehicles towing caravans involved in the crashes under study.

Speed Limit	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
Up to 35 mph	86	16	2	17
40 mph	2	1	0	1
45 mph	24	3	0	5
50 mph	127	12	3	15
55 mph	8	1	0	1
60 mph	51	9	0	17
65 mph	1	0	0	0
70 mph	0	0	0	0
Prima Facie 50 mph	104	9	1	15
Not stated	2	1	0	1
Total	405	52	6	72

Table 8: Speed limits applying to the roads where the caravan-involved crashes studied occurred.



		<u>Frequency of Caravans</u>	
Weather conditions		Wet	Overcast, dry
Traffic conditions		Medium-heavy	Light
Speed	21-25 mph	7	0
	26-30 mph	15	3
	31-35 mph	34	9
	36-40 mph	54	36
	41-45 mph	30	44
	46-50 mph	2	19
	51-55 mph	0	1
Total No. of Caravans		142	112
Mean speed		37.1 mph	41.9 mph
Standard deviation		5.3 mph	4.6 mph

Table 9: The speed distribution of vehicles towing caravans when measured by radar on two different occasions on a straight, level four-lane carriageway near Ourimbah. The overall speed limit applying to the road was 55 mph.

Stated Speed of Vehicle Towing Caravan (mph)	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
0- 5	25	2	0	3
6-10	10	2	0	2
11-15	25	6	0	7
16-20	20	5	0	9
21-25	27	3	2 ,	3
26-30	67	6	1	9
31-35	52	5	0	6
36-40	79	5	1	7
41-45	53	10	0	16
46-50	18	5	2	7
51-55	2	0	0	0
56-60	1	0	0	0
Not stated	26	3	0	3
Total	405	52	6	72

Table 10: The distribution of stated speeds of vehicles towing caravans and involved in the crashes studied.

Mean stated speed = 31.3 mph

Standard deviation = 12.4 mph



Accident Classification	No. of Crashes	No. of Casualty Crashes	No. Killed	No. Injured
Overtuned without running off the road	91	3	0	4
Head on - including opposite direction side swipe	68	17	3	26
Side swipe - vehicle going in the same direction	54	7	1	10
Rear end	53	4	2	5
Ran off road	44	8	0	12
Jack-knifed combination on road	27	2	0	3
Fixed object on roadway	18	2	0	3
Right angle intersection collision	16	5	0	5
Other crash types	34	4	0	4
Totals	405	52	6	72

Table 11: Broad groupings of the accident classifications and vehicle manoeuvres of the crashes involving cars and similar vehicles towing caravans.

Stability Factors

A. Swaying

Swaying only	=	1
Swaying and overturn	=	<u>6</u>
		7

B. Wind

Wind only	=	7
Wind and overturn	=	19
Wind and jack knife	=	1
Wind from passing or overtaking vehicle and overturn	=	3
Wind from passing or overtaking vehicle and jack knife	=	<u>1</u>
		31

C. Overturn

Overturn only	=	23
Overturn (jack knife and .....)	=	3
Overturn (tyre failure and .....)	=	8
Overturn (brake failure and .....)	=	4
Overturn (tow bar failure and .....)	=	5
Overturn (wheel failure and .....)	=	4
Overturn (swaying and .....)	=	6
Overturn (wind and .....)	=	19
Overturn (wind from passing or overtaking vehicle and .....)	=	3
Overturn (axle/suspension failure and ...)	=	4
Overturn (side swiped and .....)	=	1
Overturn (oil/wet road and .....)	=	3
Overturn (lost control and .....)	=	9
Overturn (lost control whilst braking and .....)	=	12
Overturn (rough road and .....)	=	<u>9</u>
		113



D. Jack Knife

Jack knife only	=	8
Jack knife (braking and .....)	=	8
Jack knife (overturn and .....)	=	3
Jack knife (tyre failure and .....)	=	3
Jack knife (wet road and .....)	=	1
Jack knife (rough road and .....)	=	1
Jack knife (tow bar failure and .....)	=	2
Jack knife (wind and .....)	=	1
Jack knife (wind from passing or overtaking vehicle and .....)	=	1
Jack knife (brake failure and .....)	=	1
		<hr/>
		29
		<hr/>

E. Other Stability Factors

Lost control	=	10
Lost control (rough road and .....)	=	1
Lost control and overturn	=	9
Lost control whilst braking and overturn	=	12
Wet roads	=	8
Wet road and jack knife	=	1
Oil/wet road	=	2
Oil/wet road and overturn	=	3
Loose gravel	=	3
Rough roads	=	2
Rough roads and jack knife	=	1
Rough roads and overturn	=	9
Braking and overturn	=	8
		<hr/>
		69
		<hr/>

Table 12: (Cont.)

Mechanical Failure Factors

Coupling/tow bar/tow ball failure	=	6
Coupling/tow bar/tow ball failure and overturn	=	5
Coupling/tow bar/tow ball failure and jack knife	=	2
Caravan brakes failure or defect	=	3
Caravan brakes failure of defect and jack knife	=	1
Caravan brakes failure or defect and overturn	=	4
Caravan axle/suspension failure	=	2
Caravan axle/suspension failure and overturn	=	4
Caravan wheel failure and overturn	=	4
Caravan tyre failure	=	8
Caravan tyre failure and overturn	=	8
Caravan tyre failure and jack knife	=	3
		<hr/>
		50
		<hr/>

Table 12: Analysis of caravan-involved crash characteristics and possible contributing factors. Note that where one factor was associated with another, the crash was noted under both classifications - for example, where a car-caravan combination jack knifed and overturned, it was listed under

"jack knifed and overturned" and also under  
"overturned (jack knifed and .....)".



Vehicle Types	No. of Crashes	No. Of Casualty Crashes	No. Killed	No. Injured
Cars	260	32	3	50
Station Waggon	48	8	3	9
Utilities	37	2	0	2
Panel Vans	15	6	0	7
4-Wheel Drive Vehicles	8	1	0	1
Other	2	0	0	0
Not Stated	35	3	0	3
Total	405	52	6	72

Table 13: Types of vehicles towing the caravans involved in the crashes studied.

Vehicle types	Number	Percentage of total
Cars	216	85.0
Station Waggon	24	9.4
Utilities	10	3.9
Panel Vans	2	0.8
4-Wheel Drive Vehicles	2	0.8
Total	254	100

Table 14: Types of vehicles towing caravans  
observed during speed measurements  
at Ourimbah, January, 1974.



Ratio	unladen caravan weight unladen towing vehicle weight	No. of Crashes	no. of Casualty Crashes	No. Killed	No. Injured
	less than 0.30	11	2	0	3
	0.30 - 0.39	11	1	0	4
	0.40 - 0.49	25	3	0	3
	0.50 - 0.59	71	8	3	9
	0.60 - 0.69	70	9	0	11
	0.70 - 0.79	40	7	0	8
	0.80 - 0.89	17	0	0	0
	0.90 - 0.99	14	3	0	5
	1.00 - 1.09	6	1	0	2
	1.10 - 1.19	3	0	0	0
	1.20 - 1.29	2	0	0	0
	1.30 and over	3	0	0	0
	Weight(s) not obtainable	132	18	3	27
Total		405	52	6	72

Table 15: The distribution of the ratios of unladen caravan weight to unladen towing vehicle weight of the vehicles involved in the crashes studied.

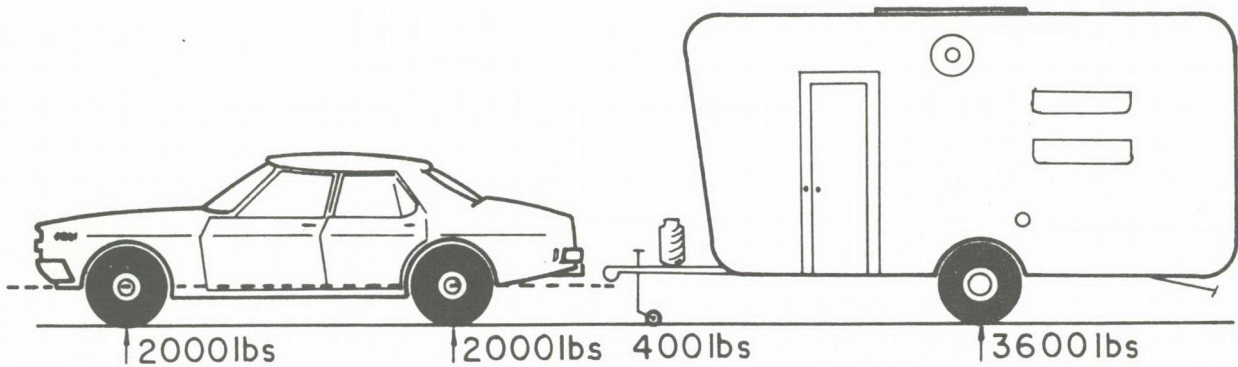
Location	Limits on L or P drivers towing caravans	Any special speed limits for caravans	Any special restrictions on the ratio of towing vehicle wt. to caravan wt.	Whether persons permitted to ride in caravans
New South Wales	No special limits	Where laden weight exceeds 15 cwt, 45 mph limit	Caravan laden wt. not to exceed unladen wt. of car or station waggon	No
Victoria	L drivers not permitted to tow trailer or other	When laden weight exceeds 1 ton, 40 mph limit. Otherwise 45 mph	No specific reference found	No
Queensland	No special limits	No special limits	Laden wt. of caravan fitted with "override" brakes not to exceed unladen wt. of towing vehicle	No
South Australia	No special limits	No special limits	No special limits	No restrictions
Western Australia	No special limits	When laden weight exceeds 15 cwt, 45 mph limit	If have no caravan brakes, caravan laden wt. not exceed unladen wt. towing vehicle. If have caravan brakes, caravan laden wt. not exceed 1½ times unladen wt. towing vehicle	No
Tasmania	No special limits	No special limits	Caravan laden wt. not to exceed unladen wt. of motor vehicle, utility or station waggon	No restrictions
A.C.T.	No special limits	No special limits	No special limits	No restrictions
Northern Territory	No specific reference found	No specific reference found	No specific reference found	No specific reference found

Table 16: Restrictions placed on the towing of caravans in various locations.

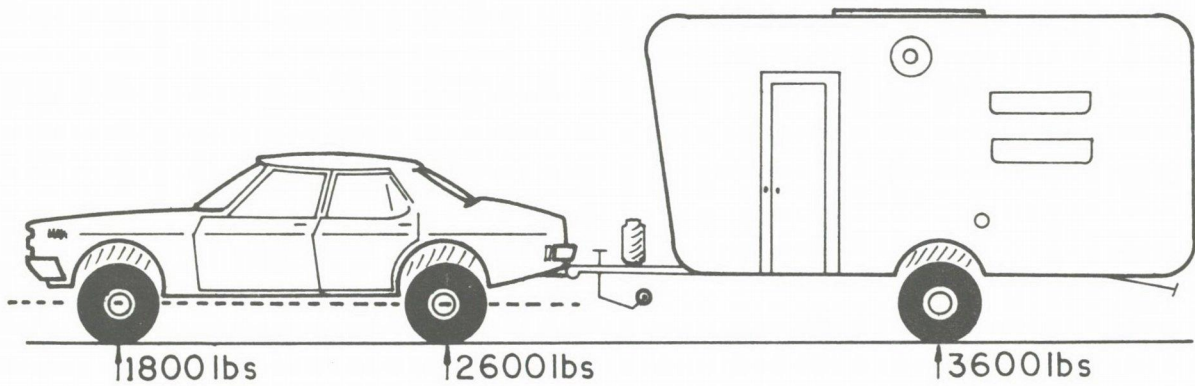


Location	Limits on L or P drivers towing caravans	Any special speed limits for caravans	Any special restrictions on the ratio of towing vehicle wt.to caravan wt.	Whether persons permitted to ride in caravans
U.S.A.	No specific reference found	45 mph	No specific reference found	No
Britain	No specific reference found	50 mph	No specific reference found	No specific reference found

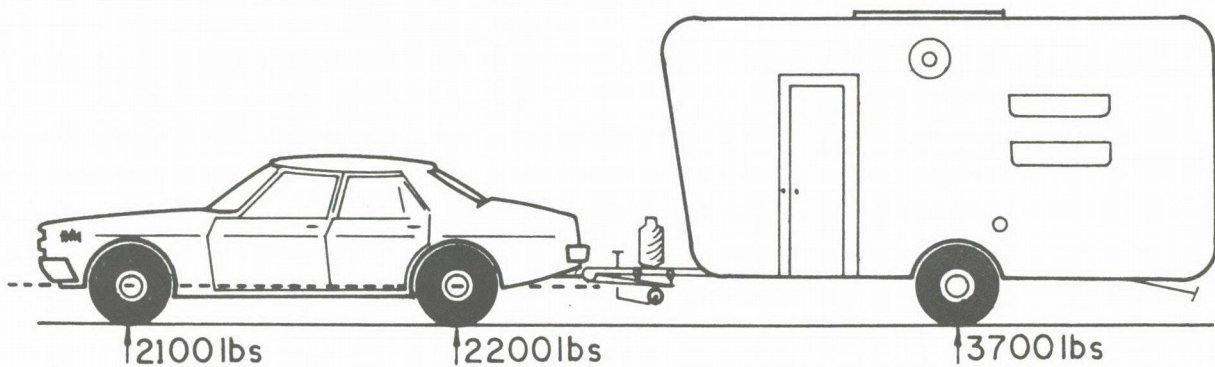
Table 16 (cont.): Restrictions placed on the towing of caravans in various locations.



CAR AND TRAILER SEPARATED



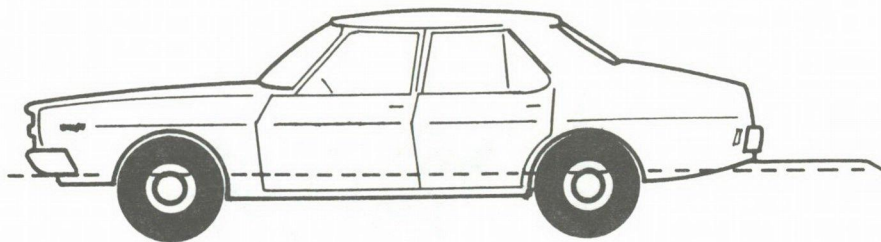
TRAILER COUPLED TO CAR EQUIPPED WITH OVERLOAD SPRINGS



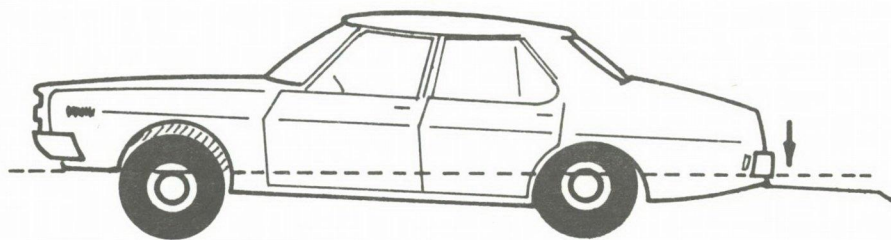
TRAILER COUPLED TO CAR EQUIPPED WITH LOAD EQUALIZER

Figure 1: Load distribution comparison.

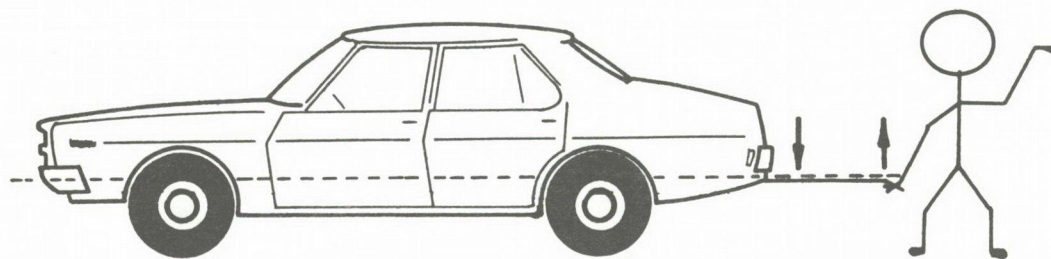




(a) Vehicle attitude before attaching a caravan to coupling.

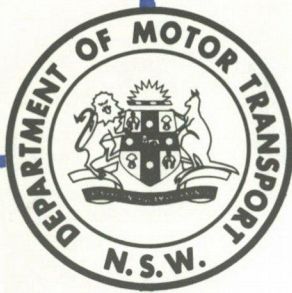


(b) Vehicle attitude with caravan attached without using a load equalising coupling.



(c) Vehicle attitude with caravan attached and using a load equalising coupling.

Figure 2: The principle of operation of a load equalising coupling.



# TRAFFIC ACCIDENT RESEARCH UNIT

# information

Caravans do not contribute unduly to traffic accidents, according to a report released today by the Department of Motor Transport's Traffic Accident Research Unit.

Research on which the report is based sets out to examine the suggestion that towed caravans constitute a special traffic problem and that special restrictions should be placed on their use.

Of 1181 people killed on N.S.W. roads in the year to June 30, 1973, six died in accidents involving caravans. This is only half of one percent. An even smaller proportion - one-fifth of one percent, 72 out of 38,301 - were injured in caravan crashes during the same period.

The report, based on analysis of more than 400 caravan accidents refutes the idea that 'vans constitute a major traffic hazard.

Of the accidents examined, only five resulted in fatal injuries, and in two of these, the involvement of caravans appeared to have no real bearing on the accident.

Nor were there any grounds for placing special restrictions on the type of driver allowed to tow caravans, the report revealed. In the crashes studied, 81 percent of drivers had 10 or more years driving experience, and only one percent had less than one year's driving experience.

The accident study influenced an earlier Government decision to lift the speed limit for caravans and trailers weighing more than 762 kg (15 cwt) from 45 mph to 50 mph (80 kph). This was effected when metric speed limits were adopted on July 1.

**Traffic Accident Research Unit, 56 Rothschild Avenue, Rosebery N.S.W.**



This decision was made in part as a safety measure, the report pointing out that increasing the "spread" of speed in a traffic stream increases the crash potential of that traffic stream.

Instability of vehicle/caravan combinations, which often led to roll-overs, head-on and side-swipe crashes, was seen to be the principal single factor in causing caravan crashes.

In an effort to minimise the danger of crashing, caravan owners should take a number of simple precautions, the report added. These include more <sup>(u)</sup> sidespread use of load equalisers, larger tyres on caravans and the rear wheels of towing vehicles, and the secure location of loads which might otherwise move around with the motion of the 'van.

Ideally, the vertical load on the coupling between car and 'van should be about 10 to 15 percent of the caravan weight, the report added.

For further information contact -

Barry Cooke,  
Publicity Officer,  
Traffic Accident Research Unit.