# VEHICLE ENGINEERING REPORT

## BUS/SEMI-TRAILER CRASH NEAR GRAFTON, 20 OCTOBER 1989

### INTRODUCTION

This report presents some first observations on a multiple fatality bus crash at Cowper near Grafton on 20 October 1989. The accident occurred at about 4 am. The authors visited the scene of the accident and examined the two vehicles involved at about 1 pm that afternoon. By that time the rescue work had been completed, the bus had been moved to Grafton and the truck was about to be towed to Grafton. It is stressed that the authors were not able to examine the vehicles in-situ.

### GENERAL DESCRIPTION OF THE CRASH

At night on a two lane, two-way rural highway (the Pacific Highway, near Cowper) an articulated truck travelling south collided with a tourist coach travelling in the opposite direction. The initial impact was at the front left corner of each vehicle. Marks in the road indicate that the truck was about half-way across the opposite lane when the impact occurred. The truck then proceeded to shear off the whole of the left-side of the bus. The bus then veered to the side of the road and tipped on its side (it did not appear to have rolled over, as indicated in initial media reports).

The truck driver was killed in the accident. The truck cabin was extensively deformed, indicating severe crash forces. There was also deformation to the front right side corner of the semi-trailer tray and the front gate of the semi-trailer.

Nineteen bus occupants were killed in the crash and a further twenty three received serious injuries (including the driver). The modes of injury were not clearly evident at the time of examination of the bus but are likely to have involved the following:

a) Impact with components of the truck (bull-bar, cabin and/or semi-trailer tray front) as it sheared along the side of the bus. The passenger seats along the right side of the bus were missing when the bus was examined and it appears that they had been ripped out during the shearing process.

b) Ejection from the bus.

c) Impact with interior components of the bus, particularly seat components. Many of the seats had been torn from their anchorages and/or had broken.

### ROAD ENVIRONMENT

Ambient conditions: Night-time, possibly wet road. Visibility unknown but likely to have been good.

Road Alignment: Straight, horizontal section of road.

Lane Width: About six metres, which is typical for these sections of highway.

Road Shoulders: Soft, grassy shoulders about 5 metres wide which slope off relatively steeply to drainage channels.

Pavement: Coarse bitumen in good condition.

Traffic Controls: Single broken centre-line for several hundred metres on either side of the crash site. 100 km/h speed zone (open road).

Roadside Objects: Fences and trees approximately 8 metres back from the roadway. Apparently not a hazard.

Possible Countermeasures: Wider lanes, improved road shoulders (it was noted that other, adjacent sections of highway deserve priority for road improvements - the section in question was comparatively good).

**VEHICLE FACTORS**

TRUCK

The truck was an International prime mover hauling a table-top semi-trailer with gates (railings) on all sides. The load was packs of fruit juice in cardboard boxes.

The reason for the truck veering into the opposite lane is unknown. The Police Accident Investigation officers took parts of the truck so it was not possible to assess the condition of the steering system. In any case, massive damage occurred to these components during the impact.

The road surface was covered with dirt (as part of the clean-up operation) at the time of examination of the crash site and therefore it was not evident whether there were skid marks from the truck.

The front of the truck and the right side of the cabin were extensively deformed (see photographs). The driver was probably pinned between the seat and the steering column.

Generally the truck appeared to be in good condition prior to the crash. It was noted that the semi-trailer turntable was intact despite the substantial crash forces. The truck was booked in for its first annual RTA inspection at Tweed Heads on 26 October 1989. An interim registration renewal had been issued by Narrabri Motor Registry, pending the RTA inspection.

Possible Countermeasures:

- Improved cabin strength (to improve protection for truck occupants)
- Reduced aggressivity of bull-bar and semi-trailer tray front (to improve protection for occupants of other vehicles).

BUS

The bus was a single deck Scania/Austral Express coach with Federal Interstate registration numbe[illegible] (issued in Queensland). [illegible]. The seating capacity was not noted. It is understood that most of the passenger seats were occupied at the time of the crash.
The main impact forces appear to have been taken by the chassis cross members adjacent to the right hand front wheel. The right side of the bus was completely removed from the front corner through to the rear corner. The side of the bus was concertined into a pile of metal tightly compressed and containing components of bull bars. Both the bus and truck had bull bars of similar design. It was not possible to determine from the wreckage which bull bar (or indeed if both bull bars) was included in the compressed side of the bus. The component or components of the truck which led to the complete ripping out of the side of the bus were not able to be clearly identified at the time. Some likely components were the front bumper bar of the bus which was heavily bent backwards and was at the level appropriate to the lower section of the bus side. Some transverse low structural members of the bus at about the same height were also bent back. The upper section of the bus structure might have been removed by the truck's bull bar, cabin and door frame, the semi-trailer tray front or a combination of these components. The roof pillars and side of the bus appeared to have offered very little resistance to intrusion from components on the truck. It was noted that the floor structure was intact up to the full width of the bus but bus components above and below this plane appeared to have been impacted up to a depth of about 600mm along the entire length of the bus. The rear, right-side roof pillar (a square steel tube) had been severely impacted but was intact.

The bus seats were mounted to the floor on the aisle side and to the walls of the bus on the far side from the aisle. The bracket to the floor on the aisle side comprised a steel fabrication from both metal sheet and metal strip. There was evidence of these brackets distorting and occasionally failing. Many of the anchorages of the seat near the aisle pulled completely away from the plywood floor. A stronger sub structure and better anchorages of the seat would have prevented this mode of failure.

Some of the seat upper structure (including the arm rests structure) was of dye cast material - apparently aluminium. Many of these components fractured (because of their lack of ductility) and this resulted in many jagged metal edges throughout the seating area. This would presumably have added to the injuries sustained by the bus occupants.

The injuries to the bus passengers who were not directly impacted by the truck are likely to have been reduced if the seats had been better anchored in the vehicle. This would only be true if the seats themselves were also stronger and less likely to produce ragged injury producing failure modes. One of the important factors which should not be overlooked is that the outer edge of the seats were anchored to the wall of the bus. Had these seats been anchored to the floor there might not have been any difference in this particular crash (because of the apparent depth intrusion of the truck) but in less intrusive accidents where the bus wall is damaged, the anchoring of the seats to the floor rather than the side wall might well have made a big difference.

The most destructive feature of this crash appears to have been the depth of penetration by the truck through the bus (and visa versa). Some form of protective structure at the front corner of the bus may well have substantially reduced the severity of the crash by deflecting the truck away from the bus and preventing its full length penetration of the bus.

The overall structure of the bus was reasonably intact, bearing in mind the crash dynamics. Generally, the bus appeared to be in good condition prior to the crash. It was noted that the Police recovered a tachograph from the vehicle.

Possible Countermeasures:

- Improved structure at the front of the bus to resist intrusion from the front, at the level of the passenger deck.

- Improved structure along the side of the bus to resist intrusion from the side.

- Improved seat design so that seats are better able to withstand crash forces. Avoidance of materials which fracture to expose sharp jagged edges.

- Seat belts for bus occupants.

**DRIVER FACTORS**

TRUCK

It is conceivable from what little is known about the crash at this stage that the driver worked exceptionally long hours and it is known from reports that he falsified his log book. Some form of reliable recording device would have enabled this information to have been established reliably and, more importantly, would have enabled police in a prior booking of the driver to have identified that he was driving for too long a time.

On the previous encounter with the police, the driver stated that he was not carrying a log book and was therefore subjected to a fine of $30. In fact he was carrying a log book as we now know. The fine for not carrying a log book should be substantially increased to make if not worthwhile hiding the fact that the driving times were being falsified.

There is still the problem of multiple log books and perhaps police should have the authority to search vehicles for multiple log books. If multiple log books are found, the driver should be subjected to a heavy fine and possible arrest.

One suggestion which was made was the use of a bundy clock system. Drivers would be required to carry a bundy card which would be stamped periodically by intercepting RTA or police officers. If the time and location data on the previous entry the bundy indicated that the driver has been travelling for too long or too fast, the driver could then be arrested on the spot. This system was suggested by a police officer at Grafton. There are some apparent flaws with this suggestion but it should be considered in conjunction with other measures to enforce driving hours limits.

More intensive enforcement of log book legislation would also be something that could be quickly and easily introduced and if coupled with heavier fines and perhaps enhanced police powers for searching for log books, might have some beneficial effect.

The better way of recording movements, speeds and driving hours would be by use of an electronic trip recorder. Such an electronic recording device would need to have a standard interfaced protocol so that intercepting RTA or police officers could plug the unit into a laptop computer and immediately obtain records. At the same time, these records (indeed all records from tachographs) only disclose movements of the truck and not whether the driver has, for example, been driving another vehicle within a prohibited period. A way around this would be to require a "smart card" which is carried by the vehicle driver and plugged into the vehicle's electronic trip recorder. The smart card would in turn record the vehicles that the driver has been using in the preceeding defined period.

There are already electronic recording devices but they do not use smart cards and the interfaces between the devices and external monitoring equipment are not defined at the moment. Mechanical tachographs are widely available but have some enforcement weaknesses. [redacted] It would be feasible [redacted] to require the fitting of at least mechanical tachographs to all heavy vehicles. The logistics of obtaining tachographs and fitting them might be difficult but a commencement date of July 1990 should be achievable. Current generation electronic trip recorders should be an acceptable alternative to tachographs. The introduction of more sophisticated electronic devices, with provision for smart cards and roadside testing would require a longer lead time - possibly two years (i.e. January 1992).

BUS

There are indications that the bus [redacted] braked severely just prior to the impact and was travelling at about 40 km/h at the point of impact. Presumably this information was derived from the tachograph chart.

Further details about the drivers should be obtained from the Police accident report.

Possible Countermeasures:

- Speed limiting (the accident occurred in a 100 km/h speed limit zone).
- Trip recorder (e.g. tachograph) to monitor driver speed and hours of driving.
- Increased enforcement of speed limits and driving hours regulations by the Police and RTA, including enforcement of owners responsibilities regard the driving hours of employees.

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