Contributed Articles

Recent ARRB research on heavy vehicle safety

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Abstract

Deaths from heavy vehicle crashes represent 16% of the national road toll, with an estimated cost to society of $2 billion per year. The future will see a significant growth in road freight transport, and so this problem is likely to increase. This paper presents key findings from a research program on heavy vehicle safety undertaken by ARRB and funded by Austroads. Projects include the safety of heavy vehicles in urban areas, and in rural and remote areas; the interaction between heavy vehicles and the road system; and heavy vehicle driver gap selection at intersections. Future research directions are also provided.

Keywords

Heavy vehicles, Road safety, Urban, Rural, Gap selection

Introduction

In Australia, deaths from heavy vehicle crashes represent 16% of the national road toll, with an estimated cost to society of $2 billion per year. During the 12 months to the end of September 2010, 250 people died from 209 crashes involving heavy trucks or buses. The majority of these crashes (60%) involved articulated trucks, followed by heavy rigid trucks (32%) and buses (8%).

The future will see a significant growth in road freight transport. The capacity of urban and rural road systems to cope with this increase safely and efficiently will be fully tested. The development of measures to improve the safety of heavy vehicle travel is an important part of the road research program undertaken by ARRB and funded by Austroads[1] . ARRB's recent research for Austroads in this area has focused on the following issues:

- the safety of heavy vehicles in urban areas, and in rural and remote areas
- interaction between heavy vehicles and the road system
- heavy vehicle driver gap selection at intersections.

An outline of the aims and findings of these projects follows.

Improving the safety of heavy vehicles in urban areas

It is estimated that by 2020 road freight travel in Australia will be more than double that of 2000. While there are differing views on the future magnitude of the freight task, there is acknowledgement that freight activity in Australia will increase substantially in a relatively short timeframe. The freight forecasts indicate that the greatest increases will occur in urban areas. It is expected that the freight growth will occur mainly near and/or between ports, inter-modal freight terminals, and outer metropolitan industrial areas where large warehouses and distribution centres are located.

If the high levels of projected growth are realised, there will be significant safety implications, particularly as heavy vehicles need to share an increasingly constrained and congested road network with other road users.

The project sought to establish the issues relating to heavy vehicle operations on urban roads, and to develop effective measures to improve safety. The study examined:

- the magnitude, severity, characteristics and trends in crashes
- current knowledge regarding road-based causes
- safety improvements with an emphasis on intelligent transport systems (ITS) and other new technologies.

The study approach included crash data analysis, a literature review, consultations with key stakeholders, and a review of the *National Heavy Vehicle Safety Strategy 2003–2010* and the associated action plans.

It confirmed that most heavy vehicle casualty crashes in urban areas in Australia occur in 60 km/h zones. However, articulated truck crashes are more frequent in 70, 80 and 100 km/h speed zones. This reflects the very small proportion of travel that is undertaken by articulated vehicles on non-arterial roads in urban areas.

The literature review highlighted a range of measures to improve heavy vehicle safety in urban areas such as developing safer roads (e.g. separate truck facilities), achieving more alert and compliant road users (e.g. increased enforcement) and encouraging safer vehicles (e.g. under-run protection for heavy vehicles). The focus of the study, however, was on ITS solutions and some of the technologies for which crash reductions have been demonstrated include:

- electronic braking systems
- intelligent speed adaptation (particularly speed limiting systems)
- lane departure warning systems
- road geometry warning systems.

A number of technologies are promising and are being trialled, but require further evaluation to establish their contribution in actual operation.

Heavy vehicle safety in rural and remote areas

About 60% of road fatalities in Australia occur on roads in rural and remote areas. While there have been substantial reductions in crashes in urban areas, in general these have not been matched in rural and remote environments.

The objectives of the study were to update trends and undertake a detailed investigation of crashes in rural and remote areas in order to identify:

- existing measures which could be used more widely or more efficiently
- new and cost-effective measures
- improvements to current road design and traffic engineering practices
- locations and parts of the road network that will come under pressure from increased freight movements.

With the predicted increase in freight activity, it can be expected that heavy vehicle crashes will also increase unless effective safety measures are undertaken. A review of the likely growth in the freight task identified that the key short and long interstate haul routes between capital cities are expected to experience sustained growth of 3% to 4.6% per year up to 2020.

Site investigations of a representative sample of heavy vehicle crash locations identified a range of road factors involved. Information on these factors was subsequently used to identify remedial works. Major crash factors included:

- Intersections – poor sight distance, delineation either not provided or inadequate (i.e. linemarking, raised reflective pavement markers, edgelines and guide posts), unsealed or only partially sealed shoulders, insufficient or poorly positioned signing, roadside hazards located within the clear zone (e.g. poles, culverts and steep embankments), safety barriers either not provided or inadequate, insufficient advisory/warning signs (e.g. of curves, intersection ahead, advisory speed).
- Road segments – poor road pavement (i.e. not well maintained, inadequate drainage, too narrow), unsealed or only partially sealed shoulders, unexpected transition between roads of varying standard, poor sight distance for overtaking, insufficient or poorly positioned signing, roadside hazards located within the clear zone (e.g. trees, poles, culverts).

Safety improvements can be undertaken either as part of a maintenance or a capital works program. The approach adopted should focus on high volume arterial roads, freight routes, the level of crash risk, and rates of increase of heavy vehicle activity.

Road maintenance programs should ensure regular attention to:

- road delineation features (i.e. edge, lane and centre-of-the-road linemarking, raised reflective pavement markers, chevron alignment markers, guide posts)
- regulatory, advisory and hazard warning signs (including placement and positioning)
- road shoulders and road surfaces
- sight distance at intersections (e.g. removal of obstructing vegetation).

Capital works programs should include:

- expanding the provision of passing lanes
- installation of safety barriers designed for heavy vehicles at locations where there is a high run-off-road risk
- installation of median barriers (including wire rope barriers) and increased separation of opposing lanes of traffic (e.g. wider barrier lines, increased spacing between double barrier lines)
- provision of sealed road shoulders on freight routes
- improvement of sight distances at major road intersections
- improvement of the delineation and conspicuity of intersections (e.g. linemarking, guide posts, raised reflective pavement markers and islands)
- provision of clear zones (e.g. removal of hazard, flattening of batter slopes).

Road authorities should continue to invest in improvements at heavy vehicle crash sites at intersections and road segments with both mass action programs and blackspot treatments. These programs are highly effective in reducing crashes at locations that have inherent safety problems.

Improving the interaction between heavy vehicles and the road system

The project evaluated the interaction between heavy vehicles and the road system in order to identify issues related to heavy vehicle crashes and develop proposals to improve the road system on heavy freight routes. The approach involved:

- an overview of heavy vehicle crash characteristics
- identification of freight routes with safety problems
- development of a draft strategy to improve route safety
- identification of revisions to the Austroads *Road Safety Audit* guide to take better account of heavy vehicle safety issues.

An analysis of crash data indicated that the characteristics of heavy vehicle crashes matched those for all types of crashes, at least for some of the variables investigated. However, they differed in some respects; for example, 'same direction' crashes account for a higher proportion of heavy vehicle crashes.

Inspections of heavy vehicle crash cluster sites along selected freight routes identified the road and road environment factors which may have contributed to the crash or its severity. These included poor delineation, narrow lanes, limited sight distance and clear zone hazards.

Treatments which could form part of a strategy to address heavy vehicle safety on major routes in the short term and the longer term were identified. Some of these confirmed measures are already in the *National Heavy Vehicle Strategy 2003-2010*, such as the clearance of roadside hazards, shoulder sealing, provision of passing lanes, and programs to minimise the risk posed by utility poles.

Further investigation of other promising measures such as the use of barriers to reduce the risks posed by roadside hazards, audible edgelining for heavy vehicles, and improved delineation was required. Other longer term measures warranting support include skid-resistance treatments and greater lane widths.

Heavy vehicle driver gap selection at intersections

The project sought to measure the gap sizes selected by drivers of heavy vehicles for a number of turning/crossing manoeuvres at intersections. Driver gap-taking decisions were analysed at six sites. Four were located in Melbourne and two in Brisbane; four sites were T-intersections and two were cross-intersections. The sites consisted of standard intersection geometry which satisfied ARRB selection criteria. Road-mounted traffic counters and video cameras were placed at each site, and data was recorded continuously for a period of approximately seven days.

The five heavy vehicle classes analysed in this study were:

- medium rigid truck
- heavy rigid truck
- semi-trailer
- truck-trailer
- B-double.

Data were only analysed during daytime hours (approximately 7.00 am to 5.30 pm), when the road was dry and when the driver of a subject vehicle made a complete stop before performing the entry manoeuvre.

It was found that the gap size chosen by the driver for the five vehicle classes increased in line with the size of the vehicle, namely medium rigid, heavy rigid, semi-trailer, truck-trailer and B-double. [2] This was an expected result as the latter vehicle classes have a longer length and a larger mass. The B-double vehicle class had a significantly larger gap size than the other classes. Gap sizes for the medium rigid, heavy rigid and semi-trailer vehicle classes were very similar for the majority of manoeuvres.

Further measurement of driver gap selection at night, during wet weather, and with laden and unladen vehicles would also provide valuable information on driver behaviour.

Future research directions

Heavy vehicle safety will remain an important area of research for Austroads and ARRB. The directions for future research are likely to include:

- assessment of the most promising vehicle technologies with an emphasis on intelligent transport systems
- investigation of representative heavy vehicle crash locations in order to identify the causes and risk factors
- development of measures in support of the national heavy vehicle safety strategy and action plans
- review of speed limits in relation to road standards and roadside development
- improvements in road design and traffic management practice which take greater account of their interaction with heavy vehicles
- the suitability and application of safety barriers to reduce the risk for heavy vehicles from roadside hazards
- review of the design of intersections on key freight routes to accommodate heavy vehicles more safely.

Notes

[1]Austroads membership comprises the Australian state and territory road transport and traffic authorities, the Commonwealth Department of Infrastructure and Transport, the Australian Local Government Association, and the NZ Transport Agency. Its purpose is to contribute to improved transport operations including the fostering of research in the road sector.

[2]The gap range for each vehicle was found to be: medium rigid (4.6 to 8.6 seconds), heavy rigid (5.2 to 7.2 seconds), semi-trailer (6.6 to 9.6 seconds), truck-trailer (5.0 to 9.6 seconds) and B-double (7.8 to 12.0 seconds).

Large truck crash avoidance

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Abstract

Large truck and other commercial vehicle crash causation can be conceptualized by a risk-cause timeline and model. Different types of risk factors interact continuously to raise or lower crash risks, though crashes are usually precipitated by a discrete driver error or other failure. Enduring individual differences in driver risk are strong, with personality and related risk attitudes as a major source. Roadway characteristics (e.g., divided vs. undivided roads) are comparable to driver differences in their effects on risk. For motor carriers, a distinction can be made between risk *reduction* (i.e., improving drivers and vehicles) and risk *avoidance*(reducing exposure to risk). Both can be effective strategies.