Cycling and heavy vehicles

Purpose

This note aims to raise awareness of the types of problems encountered between bicycle riders and heavy vehicles. It describes:

- the nature of crashes between road users and road environment design, and
- suggestions to improve design of the roadside environment to address potential conflicts.

Definitions

Trucks are defined as those vehicles over 4.5 tonnes maximum permissible gross vehicle weight. In this note, all large heavy vehicles, including buses and coaches (whether articulated or rigid) are referred to as "trucks". They can include multi-combination vehicles (e.g. B-doubles and road trains).

Cycle route networks

Where possible, designated cycle routes (as part of Local Cycle Network Plans and Integrated Regional Cycle Network Plans) should be planned to avoid locations that are frequently used by trucks. Where this is not possible, alternative provision (e.g. off-road cycling facility, shared High Occupancy Vehicle (transit) lane, exclusive bicycle lane) should be made. Protected space or priority treatments are therefore needed where bicycle riders are likely to come into conflict with trucks. On designated routes with a significant number of trucks, physical segregation or an alternative route will be preferred by most bicycle riders. This may be achieved by:

- directing bicycle riders along quieter side streets and away from busier intersections
- offering signed routes through vehicle restricted areas or road closures
- constructing off-road bicycle facilities.

However, it must be remembered that designated cycle routes need to be direct, convenient and comfortable if they are to be well used. If an alternative route involves a significant detour or increase in gradient, then cyclists may refuse to adopt it. This undermines the value of any improvements to the alternative route. In any case, bicycle riders may still choose to use the truck routes. Hence, *all* roads should be cycle-friendly.

In space constrained urban areas there will always be a need to consider how best to provide for bicycle riders utilising the same road space as trucks. This includes treatment measures such as:

- wide kerb-side shared lanes and exclusive bike lanes - see Cycle Note B4 – *Designing good quality on-road facilities*
- peak period bus lanes, see Cycle Note B9 – *Bicycles and bus lanes*
- intersection treatments, see Cycle Note B6 – *Cycling and intersections* and Cycle Note B7 – *Cycling and roundabouts*
- traffic calming measures, see Cycle Note B8 – *Cycling and traffic calming.*

Aim

This series of notes aims to assist planners and engineers to provide for cycling in their local area.
The Cycle Notes should be read in conjunction with:

- Guide to Traffic Engineering Practice, Part 14 – Bicycles (Austroads, 1999)
- Queensland Manual of Uniform Traffic Control Devices, Part 9 Bicycle Facilities
- Road Planning and Design Manual (Queensland Department of Main Roads).

Contents

Queensland Government
Queensland Transport

Truck routes

When planning truck routes, consideration should also be given to avoid roads which form part of or are planned for a wider cycle network. Advisory signs can be used to direct trucks away from sensitive areas and to indicate appropriate routes. Other measures include weight and loading restrictions and the implementation of Local Area Traffic Management (LATM) schemes. Alternatives (e.g. off-road facility) to sharing road space may need to be considered if the conflict between bicycle riders and trucks cannot be resolved satisfactorily through use of the above measures.

Road freight

Trucks can legitimately use almost any road, but their size and physical operating conditions make some roads less attractive. Advisory signs can be used to direct trucks away from sensitive areas and to indicate more appropriate routes. Implementation of LATM schemes may also reduce the desirability of routes to heavy vehicles and other through traffic. It should be noted, however, that LATM schemes may also detract from the use of a route by bicycle riders.

Crash data

Queensland Transport has analysed crash data for all crashes involving bicycle riders in Queensland from 1994 to 2001. Trucks were involved in 3% of crashes involving bicycle riders but accounted for 18% of rider fatalities. The crashes involving trucks (particularly those involving articulated trucks) were more severe than for other bicycle crashes.

Analysis of *fatal crashes* shows that for the 12 bicycle rider fatalities involving trucks, seven resulted from sideswipes, two from riders pulling out into the traffic, two from a truck pulling out of a driveway and one from unknown circumstances.

Analysis of data for *all crashes* involving bicycles and trucks found that 50% of these crashes occurred away from intersections. Sideswiping by vehicles travelling in the same direction and angle crashes with vehicles pulling out of driveways were found to be common causes of crashes. Crashes involving bicycles leaving the footpath were another notable factor.

It should be noted that major road freight routes are likely to be part of the state controlled road network. In these cases, the Queensland Department of Main Roads' policy, *Cycling on State Controlled Roads* will apply. This policy seeks within certain constraints to ensure that provision is made on priority bicycle routes (via state declared road/s or suitable alternatives). On other routes, Main Roads will seek to make them bicycle-friendly where this is practicable (refer to the Main Roads' *Cycling on State Controlled Roads* for further information).

Cycle-friendly road shoulders

Cycle Note B4 – *Designing good quality on-road facilities* gives guidance with regard to making shoulders cycle-friendly. Additional information on bicycle riding on routes with heavy vehicles is discussed below.

The width of a sealed shoulder suitable for cycle routes needs to reflect the surrounding speed environment. The general minimum width should be applied (see Table 4-1: *Exclusive Bicycle Lane and Sealed Shoulder Dimensions* of *Austroads Part 14*). Wider shoulders are necessary in environments with higher vehicular speeds where greater aerodynamic forces may be expected (see below) or where there is a higher frequency of trucks. Figure 1 shows recommended sealed shoulder widths for bicycle riders. A sealed shoulder width of more than 3.0m is not recommended as it may encourage inappropriate use by motor vehicles as an additional traffic lane.

In an urban setting, provision of on-road bike lanes and their widths must also take the 85th percentile truck speed into account (see Figure 1). According to the *Queensland Manual of Uniform Traffic Control Devices*, the 85th percentile speed is defined as the speed at, or below which, 85 percent of cars are observed to travel under free-flowing conditions past a nominated point. Eighty-five percent of car drivers will be slower (and 15 percent will be faster) than this speed. This may result in consideration of a parallel, off-road bicycle facility (e.g. a shared facility on the footpath or an adjacent service road) due to overall corridor width limitations.

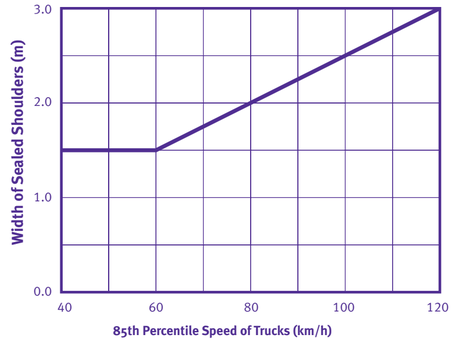

Figure 1: Recommended Sealed Shoulder Widths for Bicycle Riders
(Source: Queensland Manual of Uniform Traffic Control Devices)

Curve widening

It is imperative that the adjacent traffic lanes have sufficient width to accommodate the swept path of the particular heavy design vehicle. This may be a rigid truck, a semi-trailer or a multi-combination vehicle. The relevant local authority should be consulted to determine the appropriate design vehicle (note: this decision should also take into account any forecast changes in traffic composition). Curve widening of the traffic lanes allows larger vehicles to be fully accommodated in their traffic lane without encroaching into the shoulder (see Figure 2). For further details, refer to Main Roads' *Road Planning and Design Manual:*

- Chapter 5 – *Traffic Parameters and Human Factors*
- Chapter 11 – *Horizontal Alignment*
- Chapter 13 – *Intersections, and*
- Chapter 14 – *Roundabouts.*

Figure 2: Wide Shoulder, Rockhampton

General advantages of paved shoulders and bicycle lanes

Wide sealed shoulders and bicycle lanes may provide the following benefits to all road users:

- safety is improved for all users including pedestrians when space is clearly allocated to bicycles
- general traffic flow is improved as slower bicycle riders do not delay the general traffic when space is clearly allocated for bicycle lanes
- wide sealed shoulders allow emergency vehicles to bypass congested road conditions and quickly reach traffic incidents
- stopping sight distance and visibility is generally increased at curves and for vehicles entering the roadway from a driveway or side street
- pavement life is increased especially where sealed shoulders are added to rural roads reducing edge breaks and other pavement defects caused by motor vehicles.

Shoulders on left hand horizontal curves

Where a road has a left hand horizontal curve in the direction of travel, there is often a propensity for vehicles (in particular trucks) to "cut the corner" and encroach onto the left hand shoulder (i.e. the area often utilised by bicycle riders). Correctly designed and applied curve widening should minimise the occurrence of this encroachment.

Correct curve widening may be supplemented by additional measures in an attempt to further reduce encroachment. Examples of such treatments include:

- wider edge lines of 150mm - 200mm
- closer spacing of raised retro-reflectorised pavement markers on the edge line
- providing painted chevrons adjacent to the edge line (although this may reduce the available surface friction on painted areas)
- providing painted bicycle symbols on the shoulder (but only if it is legitimate for the sign to exist e.g. bike lane – otherwise a legal issue is raised see Figure 3)
- ensure correct curve widening is applied for the curve
- provide advanced bicycle warning signage.

Aerodynamic forces

Given the over-representation of sideswipes in crash statistics, it is important to understand the role of aerodynamic forces to minimise the potential for such crashes. Sideswipe crashes can occur without initial collision between the truck and the bicycle. Instead, the incident can be due to the "blow and suck" effect as the truck passes the bicycle rider. This effect is proportional to a truck's size, speed and distance from the rider. The aerodynamic effects of heavy vehicles are therefore critical in selecting design dimensions for cycling facilities.

Aerodynamics becomes of particular importance where traffic speeds exceed 60 km/hour.

Figure 3 derived from Main Roads (2001) *Road Planning and Design Manual*, Chapter 7 Cross Section, provides information when considering the aerodynamic effects of trucks. Crosswinds can notably increase aerodynamic effects in both directions or where the roadway is enclosed (e.g. under bridges). This can create a 'wind tunnel' effect. Additional attention should be given to the design of facilities where increased effects are considered likely to occur.

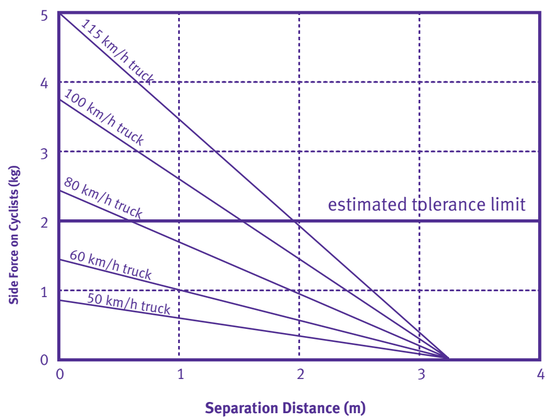

Figure 3: Truck side force impacts on cyclists

A number of design considerations are necessary where an on-road facility exceeds the estimated tolerance limits. Design measures include increasing the cross section elements (e.g. shoulders, lane widths) of the facility or providing an off-carriageway alternative. Road operational considerations may include the posting of a lower speed limit.

Urban environments

In urban environments, the use of roll-over, semi-mountable style kerb and channelling offers safety advantages to bicycle riders. It provides them with an escape route if large vehicles travel too close for safety or comfort. However, in existing road environments with straight-backed barrier kerb and channelling, limited opportunities exist to switch between on-road and off-road travel. The barrier kerb and channelling may present particular difficulties in locations where known hazards or obstructions limit the width of a roadway frequented by trucks. In such cases, an alternative off-road bicycle facility (e.g. a shared path) may be provided, with a smooth transition (e.g. kerb ramps) on and off the roadway. Appropriate signage and/or colour treatment to encourage bicycle riders to use the safer route is/are also needed.

Other references

1. Main Roads (2001) *Road Planning and Design Manual, Chapter 7: Cross Section* (August 2001), p7-22.
2. Austroads (1999) *Guide to Traffic Engineering Practice* – Part 14 Bicycles, Austroads, Sydney.
3. Main Roads (2004) *Cycling on State Controlled Roads*, Department of Main Roads, Queensland

This Cycle Note is published by
Queensland Transport.

Phone: (07) 3253 4437
Fax: (07) 3253 5858
Email: cycles@transport.qld.gov.au
Website: www.transport.qld.gov.au/cycling

Postal Address
PO Box 673
Fortitude Valley Q 4006

June 2006

Queensland Government
Queensland Transport