Speed limits in the Safe System context

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Abstract

This paper proposes a set of new principles for setting speed limits based on harm minimisation, the cornerstone of the Safe System approach. The Safe System approach seeks to develop and manage the road transport system so that death and serious injury are eliminated. Safer Roads and Safer Speeds are two of its main elements.

The new speed limit setting principles have been developed for Austroads by the Australian Road Research Board (ARRB) and road jurisdiction stakeholders. They follow the Safe System approach and have been based on recent research into the relationships between road features, speeds limits, driver speeds and crash outcomes. In the long term, application of these new principles will achieve harm minimisation through matching speed limits with the level of protection offered by the road infrastructure. As part of the new principles, a process is proposed to analyse the Safe System readiness of a road and identify the speed limit options and road improvement options required to achieve safe travel. It is recognised, however, that in the short and medium term, many of the Safe System road features may not be economically viable and not all speed limits would be immediately acceptable to the public. Thus, various harm reduction measures are proposed as interim steps towards the Safe System.

Introduction

The Safe System approach seeks to regulate driver speeds so that drivers respond to the level of protection offered by the road infrastructure. Under Safe System, speed limits should be set to maximise mobility consistent with safe travel – that is, to achieve safe mobility.

This paper proposes a set of new principles for setting speed limits based on the Safe System principle of harm minimisation, i.e., avoidance of death and serious injury due to road environment factors.[1] Various harm reduction measures are also proposed as interim steps towards the Safe System. This paper is based on the outcomes of a recent Austroads project conducted by ARRB described in detail in Jurewicz and Turner [1].

The traditional approach of speed limit setting is based on various road environment proxies for crash likelihood. These include accounting for such road features as roadside development level, number of access point and turning lanes, most of which relate to the risk of a crash event happening. The new principles propose a major evolution in a speed limit setting approach in the direction of the Safe System. They include both the likelihood and severity of crashes in consideration of speed limits. A broader range of road features is considered than previously. This way, death and serious injury due to road environment factors can be minimised over time.

Development process

In order to develop a deeper understanding of the subject, a thorough literature review was carried out, followed by road infrastructure and crash data analysis. Then, thorough consultation was undertaken with an expert panel of Austroads stakeholders drawn from road authorities' road safety managers to evaluate the new information and provide input into the new principles for setting speed limits. Finally, the new principles were formulated, presented to relevant Austroads task forces and subjected to further comments and review.

Speed limit setting principles

The prime objective of the new principles is harm minimisation while maintaining mobility appropriate to road class and function (that is, safe mobility). Thus, the principles involve a process of consideration of these two elements and the practical reconciliation of any gaps between them. The principles are as follows:

1. Mobility – what speed limit does the community expect for a given road class and function?
2. Harm minimisation – what are the safe speed limits for a given road given the existing conditions?
3. Gap analysis – Safe System Analysis evaluation of the existing level of protection offered by the road to identify speed limit and infrastructure improvement options.
4. Driver perception – management of the road environment and traffic speeds if necessary.

The consideration of each principle is a separate step in an iterative process. The result is one or more speed limit options, which may require changes to the infrastructure to provide safe travel at the recommended speed limit.

Mobility

The first principle (mobility) relates to community expectations about the travel speeds that are appropriate for different road class and function. There is a wide range of road classifications with different transport functions, intensity of traffic and mixes of road users. Many roads have more than one function. It is important to recognise this and select the mobility-based speed limit that matches expectations already held by the community. Table 1 provides a suggested hierarchy of road class and function-based speed limits recognising the current Australasian practice. Speed limits are generally set for homogeneous sections of road, so that one road class and function will fit the whole length of each section being considered.

Road class and function	Typical speed limit
Shared zones	10 km/h
Car parks, access driveways	20 km/h
Recreational areas/parks, car parks	30 km/h
Local roads with traffic calming	
Commercial streets with high pedestrian activity	40 km/h
Urban local and collector roads	
Default urban speed limit	50 km/h
Urban undivided arterials with direct access	
Urban fringe / rural living local access roads	60 km/h
Urban undivided arterials with limited access	
Urban divided arterials with direct access	70 km/h
Urban divided arterials with controlled access	
Urban fringe undivided arterial and sub-arterial roads	
Rural undivided roads of low design standard	80 km/h
Urban freeways	
Rural arterial and sub-arterial roads	100 km/h
Rural freeways	
Rural arterials of high design standard	110 km/h

Table 1. A proposed class and function speed limit hierarchy

Harm minimisation

The second principle (harm minimisation) involves determining the maximum speed that vehicles could travel on any road section under consideration without risking death or serious injury to any road user. The speed limits applied in the process are shown in Table 2. These limits were agreed by the Austroads expert group on the basis of primary research into survivability of crashes at different impact speeds. Universal application of harm minimisation speed limits coupled with a high degree of compliance on the part of road users would provide conditions under which death and serious injury would come close to being eradicated from the road system. Broad conditions were provided for applicability of these speed limits. Where more than one of the harm minimisation speed limits is applicable to a road link, the lowest harm minimisation speed limit applicable should be chosen.

Gap analysis

The third principle (gap analysis) concerns the gap between the road class and function speed limit and the harm minimisation speed limit. The Safe System Analysis (SSA) process was developed to identify options for bridging that gap with road improvements and adjusted speed limits. SSA is a risk assessment process that evaluates how the risk of death or serious injury for each applicable crash type from Table 2 can be minimised with existing or additional road features.

A selected harm minimisation speed limit may no longer be applicable if the effect of providing road safety features is estimated to raise safety to the level where the harm minimisation speed limit matches the mobility speed limit. Typically one primary or several targeted supporting road features would be required to minimise the risk of death or serious injury resulting from a given crash type.[2] In such a case, harm minimisation may be achieved at a higher speed limit – for example, the next higher applicable harm minimisation speed limit or a speed limit suggested by the road class and function. The SSA process should provide one or more speed limit options, some of which may call for road infrastructure improvements as a condition. The road authority then needs to weigh up the capital investment for improved road features (if any) against the loss of mobility due to a lower speed limit. Figure 1 illustrates the process schematically.

Driver perception

Finally, the fourth principle (driver perception) addresses any major discrepancies between the selected speed limit and the existing mean speeds. If the new speed limit is more than 10 km/h lower than the existing mean speed, it is likely to require additional measures, such as road narrowing, streetscaping or planting, education and publicity campaigns, and enforcement.

Example

Figure 2 provides an example of a suburban undivided arterial for which three speed limit and road improvement options could arise from application of the new principles. The example relates well to the process shown in Figure 1. In the example,

Crash type	Maximum impact speed tolerance	Harm minimisation speed limits	Applicability
Car/pedestrian, cyclist or motorcyclist	20-30 km/h	30 km/h	Where vulnerable road users are present in high numbers.
Car/tree or pole	30-40 km/h	40 km/h	Where unprotected road hazards exist within defined clear zone.
Car/car (side impact)	50 km/h	50 km/h	Where car / car side impact is possible at > 50 km/h (frequent T or cross-intersections or access points).
Car / car (head-on)	70 km/h	70 km/h	Where there is no separation between opposing traffic streams.

Table 2. Proposed harm minimisation speed limits and their general applicability

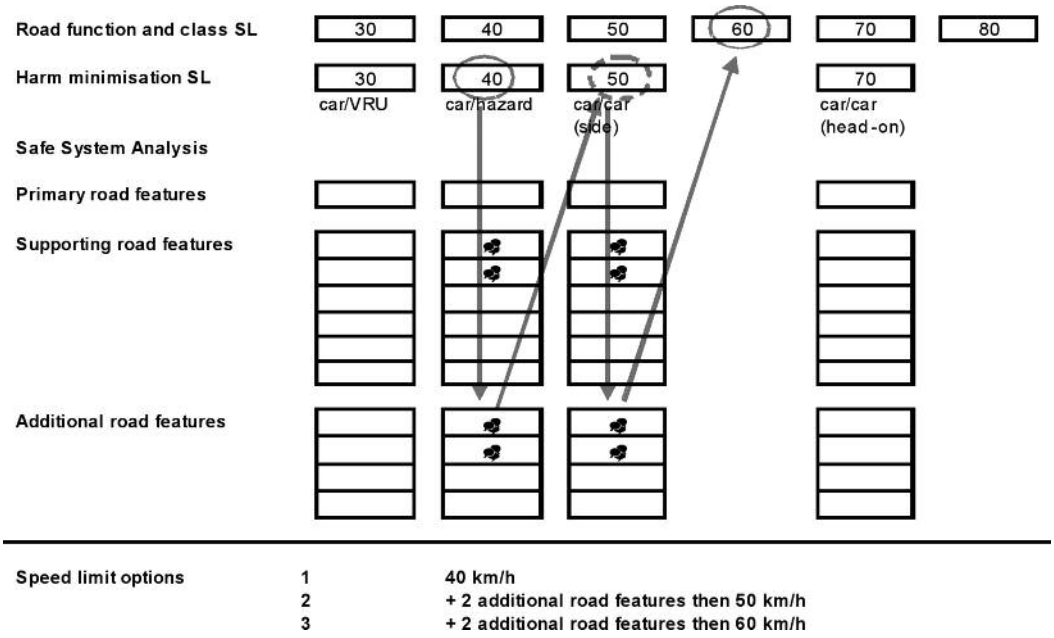

Figure 1: Schematic application of the Safe System Analysis process

the main sources of fatality and serious injury risk are roadside hazards, frequent access points and local road intersections (car/tree or pole and car/car side impacts). The mobility-based speed limit expected for such a road would be 60 km/h. The lowest harm minimisation speed limit, based on car/pole or tree survivable impact speed, would be 40 km/h (Option 1).

If the risk of death and serious injury from this crash type was addressed with relevant primary or additional supporting road features, the next highest harm minimisation speed limit would be 50 km/h based on car/car side maximum safe impact speed (Option 2). If fatalities and serious injuries from this crash type were also addressed, then the speed limit could be further increased to the mobility-based speed limit of 60 km/h (Option 3).

Safe System Analysis suggested several targeted road features that would substantially mitigate the severity and/or reduce the likelihood of both crash types. Increased clear zones to hazards by provision of well defined parking lanes would substantially reduce the risk of car/tree or pole fatalities and allow a 50 km/h speed limit to be applied. Further works, such as direct access restrictions and roundabouts at main intersections, would reduce the risk of car/car side impact fatalities and allow a 60 km/h speed limit to be reinstated.

Towards harm minimisation

In the short to medium term, the recommended road infrastructure features are not likely to be provided immediately on all roads in the system to achieve harm minimisation. Thus, a harm reduction approach may be applied while road authorities move towards the Safe System. Harm reduction involves adopting a speed limit somewhat lower than that suggested by the road class and function, but above the harm minimisation speed limit. Such speed limits would need to

Figure 2: Example of application of new principles on a suburban arterial

include driver warning/information telling motorists why the speed limit was reduced. Initially, only high risk locations should be targeted with harm reduction speed limits. In the above example, a harm reduction solution would be a reduction in speed limit to 50 km/h without any major capital works.

Further research work is required to better understand the role of supporting road features in Safe System implementation. It is particularly important to quantify the number and type of supporting treatments required for equivalence to one primary treatment in minimising deaths and serious injuries. This should be achieved through thorough empirical analysis.

In the medium to long term, a process should be established to assess the infrastructure investments needed to bring the entire network up to the standards where expected levels of mobility can be achieved safely. Restoration of speed limits lowered in the past to be in line with the road class and function should only occur once the road improvements are implemented. Medium- and long-term strategies should aim at gradual incorporation of Safe System road infrastructure in all areas of the road network, and the harm reduction approach should be abandoned in favour of harm minimisation.

The community expectation of speed limits on different types of roads may alter with time due to congestion management (for example, variable speed limits on freeways). This would reduce the gaps to be bridged through SSA.

Conclusions

Four new principles for setting speed limits in the Safe System context were presented. These principles represent an evolution of the traditional approach for speed limit setting by focussing the consideration on crash severity, crash likelihood and mobility expectations. The new principles recognise that travel should not result in death and serious injury.

It is recommended that the new principles be considered in future speed management policies. At the same time, it is recognised that implementation of speed limits fit for the Safe System will take considerable time and funding commitment. It is thus proposed that an interim harm reduction approach be applied to setting speed limits in the short and medium term.

Notes

1 The vision of zero deaths and serious injuries is based on integration of benefits of Safer Roads and Safer Speeds with Safer Vehicles and Safer Road Users. Grave harm due to human error is minimised due to road factors. It may still occur if road users choose not to comply with the road rules, for example.

2 In the Safe System context, a primary road feature alone minimises the risk of death and serious injury arising from such a crash. Examples include pedestrian overpass (car/pedestrian crash), roundabout (car/car side impact) or a median barrier (car/car head on). A supporting road feature simply reduces this risk – for example, curve delineation, audio-tactile edge lines or turn lanes. Typically, four to six targeted supporting road features should have a similar effect on a particular crash type as one primary feature.

References

1. Jurewicz, C., Turner, B.: Infrastructure/Speed Limit Relationship in Relation to Road Safety Outcomes, AP-T141/09, Austroads, Sydney.

Local government and road safety

By Cr Geoff Lake, President, Australian Local Government Association

Road trauma is one of the major public health problems facing this country. Last year 1,509 people died on our roads.

The Bureau of Infrastructure Transport and Regional Economics (BITRE) report on the *Cost of Road Crashes in Australia 2006* [1] estimates that road crashes cost the community nearly $18 billion in 2006, equivalent to 1.7 per cent of GDP. There were an estimated 653 853 road crashes in 2006 involving 1.16 million vehicles resulting in the loss of 1602 lives.

These are shocking statistics, but what they do not reflect is the personal pain and injury experienced by the people directly involved and their families and friends.

The number of deaths on our roads is only part of the problem. The latest hospitalisation figures show that nearly 33,000 people were seriously injured in crashes during 2006-07. Many of these people are now living with severe and life-long injuries. Sadly, these figures have been trending upwards for several years.

Road trauma disproportionately affects young, healthy Australians. About 30% of those killed and 37% of those hospitalised in road crashes are under 25 years old. We have all seen the images in our papers and on our TV screens. The roadside memorials are a daily reminder. Indeed, it is sobering to think that school children today are unlikely to reach the age of 25 without at least one of their former classmates being killed or seriously injured on our roads.

Much good work has been achieved over the last 40 years to make our roads safer. According to BITRE, annual road deaths have dropped from a peak of 3798 in 1970 to an average of around 1640 between 2000 and 2008, even though the number of vehicles on Australian roads has more than tripled in that time.

Tougher laws and better policing targeting speeding and drink driving, improved driver training, better road design, extensive education campaigns and new vehicle technologies have all contributed to a large reduction in the frequency, severity and economic cost of road crashes over recent decades.

Driver attitudes also need to change. According to the most recent annual survey of Community Attitudes to Road Safety undertaken by the Federal Government [2]:

- 61 per cent of respondents said they use their mobile phone while driving
- 25 per cent consider it acceptable to speed 'if you are driving safely'