Safe System Infrastructure– From Theory to Practice

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ABSTRACT

The Safe System has now been a key concept in Victoria's road safety strategy for a number of years. There is now a growing amount of infrastructure in Victoria which is consistent with the Safe System philosophy of designing the road system to be more forgiving of human error and attempting to manage crash forces to survivable levels. The infrastructure includes such things as wire rope safety barriers and roundabouts and the speed limits school and strip shopping centre speed zones.

Work has been undertaken to reach an understanding of what a Safe System philosophy means in practice. This thinking is now being utilised in road safety project designs and considered as part of broader policy decisions such as road safety performance measures for major projects.

However, there are still major challenges to overcome before the full potential of the Safe System concept is realised. These challenges include a shared understanding of what Safe System means in practice, the requirement for a significant change process to redevelop processes and standards and the high capital and maintenance costs of some Safe System infrastructure treatments.

KEYWORDS

Safe System, Road Infrastructure, Implementation

INTRODUCTION

The Safe System is now a foundation principle for the Australian National Road Safety strategy and road safety strategies in many Australian jurisdictions. In Victoria, this approach is now being utilised in road safety project designs and considered in broader policy decisions such as road safety performance measures for major projects. However, there are still challenges to overcome before the full potential of the Safe System concept is realised.

WHAT IS SAFE SYSTEM INFRASTRUCTURE?

There are two aspects to the Safe System approach:

1. The aspiration that no one should be killed or seriously injured on the road system;
2. The concept that the system, including the road and road environment infrastructure, should be such that if a person is involved in a crash the forces on their body should be at a level that would not lead to death or serious injury.

Road infrastructure to achieve the Safe System objective would either need to be such that a crash cannot occur or, if it does occur, the infrastructure is forgiving so that the forces on those involved are below that required to cause fatal or serious injury.

Under current Safe System thinking:

- The speeds set out below form the basis of the approach as they are considered to be speeds at which a person is likely to survive a crash:
    - 50 km/h for side-on intersection crashes;
    - 70 km/h for head-on crashes;
    - Between 30 and 50 km/h for run-off road crashes depending on the part of the vehicle that hits the roadside object (30 km/h if the point of impact is at the side of the vehicle).
    - 30-40 km/h for a crash between a vehicle and a vulnerable road user such as pedestrians.
- A 100 km/h rural road which was constructed with Safe System infrastructure would have:
    - A median constructed to divide opposing streams of traffic such that there could not be a head-on collision;
    - Grade separated intersections to eliminate intersection crashes;
    - Either roadside barriers to shield roadside objects such as trees or perfectly clear, perfectly driveable roadsides to eliminate Run-off-Road crashes.
- An higher speed urban arterial road constructed with Safe System infrastructure would have:
    - A median constructed to divide opposing flows;

- Either grade separated intersections or intersections that operated at a 50 km/h or less;
- Either separated road spaces for vulnerable road users (pedestrians, pushbikes, motorbikes) or operating speeds in the 30-40 km/h range.

WHAT HAS BEEN IMPLEMENTED?

Progress is being made in implementing Safe System thinking in Victoria. For example:

- Safe System speed limits in areas of high pedestrian use such as outside schools and in strip shopping centres;
- The use of roundabouts is being considered more often, as are approaches that extend the life of roundabouts, such as the use of signals to meter flows on one or a number of approaches;
- The extensive use of Wire Rope Safety barriers to reduce run-off-road trauma;
- It is beginning to be recognised that Safe System infrastructure approaches are likely to be required to ensure that road safety strategy targets are achieved.

However many still think that the Safe System concept can be further utilised to deliver significantly better road safety outcomes.

ROADBLOCKS TO ACHIEVING THE FULL POTENTIAL OF THE SAFE SYSTEM CONCEPT

The following aspects make it more difficult for the full potential of the Safe System concept to be realised:

a. Focus remaining on obtaining an incremental improvement in road safety

Traditionally road safety benefits obtained from infrastructure improvements have tended to be incremental in nature, for example the use of shoulder sealing and tactile edgelines has been shown to reduce run-off-road crashes by 10-20 percent. To consider the possibility of more comprehensive approaches that may produce significant changes in road safety requires a change in the mind set, which, while it is beginning to be adopted by road safety professionals but may not yet have been understood or accepted by all.

The importance of this aspect can be illustrated by considering that the road safety objective for the National Road Safety strategy is expected to be a decrease in fatal (and serious) crashes by at least 30% by 2020. Unless there is a dramatic uptake in ITS road safety features on vehicles (and probably also an associated transfer of control from drivers to automated systems) a major part of this reduction will need to be obtained from infrastructure improvements. It is likely that the only way this could be achieved is to maximise the road safety benefits of infrastructure works by utilising Safe System approaches.

b. The Safe System approach is not perceived to be practical as in many cases

(i) It is not cost effective to implement

The use of the Safe System approach will only give the best road safety outcome if it is an effective use of the funds available. Safe System infrastructure such as wire rope safety barriers, divided roads with median barriers or grade separated intersections can be expensive. These features can usually be justified on high volume urban freeways. However, on lower volume rural routes with smaller crash numbers it can be difficult to justify. Consequently, on these routes, low cost measures which reduce the likelihood of a crash occurring but don't eliminate it, and if a crash does occur, don't reduce the chance of it being a fatal or serious injury crash, may be an appropriate solution. Such low cost measures include sealing shoulders and installing tactile or non-tactile edgelines, improving delineation at curves and installing warning signs or rumble strips on approaches to intersections.

(ii) If it were implemented it would not be acceptable to the public

Some Safe System approaches such as lowering the speed limits to between 30-50 km/h on low volume rural roads where roadside barriers cannot be justified but there is a significant run-off-the-road crash risk, would not be accepted by the public.

In some situations there may also be other conflicting objectives (e.g. social or environmental) which may mean that the Safe System infrastructure would not be accepted. For example a pedestrian overpass may not be suitable for the streetscape or satisfy the local community's needs.

c. Where the Safe System approach is practical it is not always being implemented because:

(i) Some people don't understand or agree on, the elements of a Safe System approach

Different definitions Many, including some road safety practitioners, have used different definitions of the Safe System. Some have described any infrastructure constructed for road safety as being part of the Safe System, whether or not it is consistent with the philosophy of "even if a crash occurs a person cannot be killed or seriously injured".

There is debate about the Safe System Principles There is also debate about, and inconsistencies in, the Safe System principles currently being used. For example, about whether Safe System infrastructure should be constructed to take aberrant behaviour into account and that the Safe System speeds set out above relate to whether a person is likely to be killed in a crash, but do not take into account the risk of serious injury. There is limited information about collision speed and the risk of serious injury.

Varying levels of compliance with Safe System Principles Whether an element of infrastructure or an infrastructure feature is consistent with a Safe System can be open for debate. For example, it is usually agreed that a roundabout is a piece of infrastructure which is consistent with the Safe System in that it is designed to lower speeds to 50 km/h and that the crashes that do occur at a roundabout tend to occur at an angle closer to a rear end crash angle than a normal intersection crash. The different angle would lead to lower speed differentials between the vehicles and therefore lower forces in the crash. However, while a 50 km/h speed through the roundabout will make a fatal crash very unlikely there will still be risk of a serious injury crash.

(ii) Existing standards and planning, design, construction and maintenance processes may not currently match the Safe System approach

If a Safe System approach is being adopted for a road safety strategy then it could be expected that road design standards would reflect a Safe System approach.

Further work is required to confirm Safe System thinking and consolidate this into standards and processes. For example, Wire Rope Safety barriers may give a better outcome than providing a clearzone but this would need to be confirmed by research and then documented.

ACHIEVING THE FULL POTENTIAL OF THE SAFE SYSTEM APPROACH

Approaches to further achieving the full potential of the Safe System concept include:

a. Keeping the Safe System aspirational goal in mind

Having an aspirational goal is important to continually challenge road safety practitioners and lead them to consider innovative solutions to achieve Safe System outcomes. Current approaches supplemented by ITS also mean that a goal of no, or very few fatal or serious injury crashes, may be achievable in the foreseeable future.

b. Accept that the concept is not currently perfectly achievable

While there is some debate about, and inconsistencies in, Safe System principals as they are currently described, the problems that these can lead to are far outweighed by the achievements that can be made from their use.

The use of infrastructure that best approximates the Safe System concept is likely to give the best road safety outcome.

c. Take measures to improve Safe System infrastructure affordability

The costs of Safe System infrastructure can be reduced by:

- Investigating the cost drivers and the cost effectiveness of each significant infrastructure component and developing modified infrastructure or modified construction methods to reduce costs;
- Continuing to explore the development of further innovative solutions that can achieve Safe System outcomes;
- Letting larger contracts for the construction of the infrastructure to try and achieve economies of scale.

Processes used to prioritise projects for funding should also be reviewed to ensure that all (sometimes longer term) benefits of Safe System infrastructure are included.

d. Modify standards and processes to be consistent with the philosophy as much as possible and keep reviewing them as things change

Modifying the road design guidelines to highlight Safe System infrastructure and suggest its consideration for use as a first option, would play a major part in encouraging the use of the Safe System infrastructure, educating road designers and having a consistent understanding across the road industry of the Safe System concept.

e. Train and educate stakeholders

To ensure that Safe System infrastructure is introduced as much as possible all stakeholders need to understand the philosophy and the benefits. In addition, practitioners need to be trained in the design and implementation of this infrastructure. The key stakeholders and their role in the further adoption of Safe System principles are:

- **Senior management and other high level decision makers**- need to understand the importance of the use of Safe System Infrastructure in achieving key road safety goals and take full account of this when they make policy decisions;

- **Road designers**- need to be able to develop detailed designs which incorporate infrastructure features which are consistent with the philosophy;

- **Road planners**- need to be able to develop road alignments and road reserves that will allow for the construction of Safe System Infrastucture and to include allowance for Safe System infrastructure in the project scope ;

- **Program developers**- need to develop project assessment and prioritisation processes which recognise and fully capture the full benefits of the use of Safe System Infrastructure;

- **Construction and maintenance staff**- need to understand how to construct and maintain infrastructure to ensure it is consistent with Safe System principles;

- **Road Users**-need to recognise the increase in risk that is present when Safe System Infrastructure is not in place and to drive accordingly.