Safer Speeds for Rural Undivided Highways / Intersections / Vulnerable Road Users

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Abstract

The issue of safer speeds in regards to survivability in regards to head on crashes on undivided rural roads with 100 km/h limits, intersection crashes in regards to side impact and vulnerable road user survivability at speeds needs to be addressed from a practical point of view from a police officer with extensive crash reconstruction, enforcement and engineering expertise. These are three areas where bringing certain speed limits back to survivable limits in terms of engineering design would result in a significant reduction in road trauma.

Introduction

A large majority of the fatal collisions that are investigated by the Victoria Police, Major Collision Investigation Unit tend to be head on, run off road or loss of control type crashes on rural undivided roads where a 100 km/h speed limit is present. For the 5 year period 2005 to 2009, 45% or 650 fatal collisions occurred in 100 km/h speed zones with only 3% occurring in 110 km/h zones (freeway environment). In 2006, 44% or 147 of 335 fatalities occurred in Country Victoria in 100 or 110 km/h speed zones.

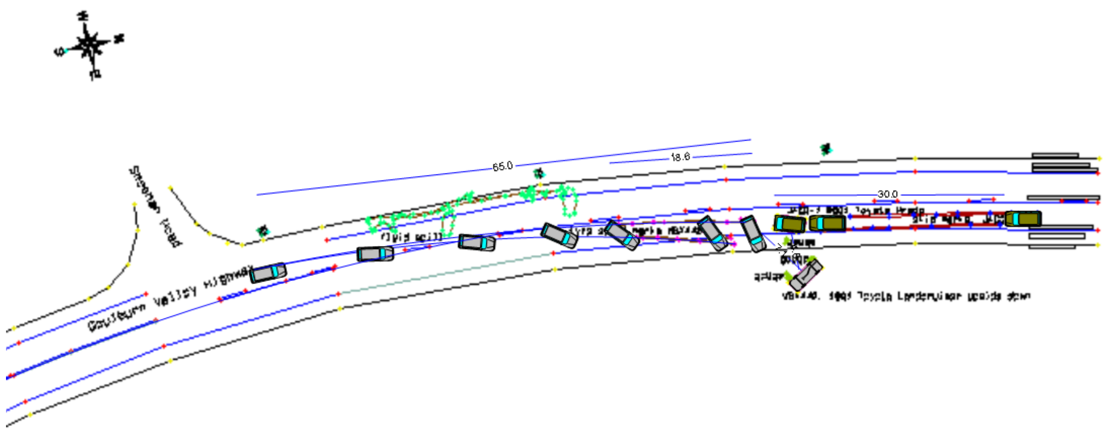
Metropolitan intersection, side impact crashes that occur in 60 km/h speed zones also tend to be over represented with 19% of fatalities occurring in this zone between 2005 to 2009.

Vulnerable road users that are struck in metropolitan areas where speed differentials are more than 30 km/h between the travel speed of the vulnerable road user and striking vehicle also account for a large number of crashes attended by the Major Collision Investigation Unit.

Research, crash reconstruction and crash data retrieval information will be explored to address survivability in regards to each of the situations above and recommendations made in regards to safer speeds, because in the end of the day why should someone loose their life or take the life of another in some instances because they made a mistake. If the safer speeds were implemented even if somebody breaks the law or makes a mistake we most likely won't have as large a loss of life or permanent injury on our roads as we still currently do, even though we have come a long way in Road Safety in the State of Victoria in the past.

Case Study: Head On, Undivided Road, 100 km/h zone

The Major Collision Investigation Unit attended a two vehicle head on collision between two four wheel drive vehicles on an undivided rural highway near the Victoria and New South Wales border. One passenger vehicle with five occupants on board, two female adults in the front, two children and one baby in the rear lost control on a slippery section of road in passing through a right hand curve in wet conditions, slid sideways into an oncoming passenger vehicle, containing two adults, a husband and wife that was initially travelling at approximately 100 km/h. The oncoming vehicle with the two occupants braked and skidded prior to impact from 100 km/h to 80 km/h. The vehicle that lost control slowed marginally whilst sliding out of control to impact at just below 100 km/h. The vehicle that slowed to 80 km/h at impact had a sudden stop undergoing a frontal speed change of approximately 80 km/h, both occupants who were restrained died. The out of control vehicle had a speed change of approximately 67 km/h during impact before it spun off and rolled post impact. Out of the five occupants in the out of control vehicle, one of the adults and one of the children received serious injuries whereas the other child and the baby received life threatening injuries. All occupants were restrained. This case study highlights a typical head on fatal collision that the Major Collision Investigation Unit attends on rural undivided highways with a 100 km/h speed zone. Obviously if both vehicles were travelling initially at say 80 km/h rather than 100 km/h the outcome would have been completely different, for example the oncoming vehicle would have slowed from 80 km/h to 40 km/h at impact which would not have resulted in a fatal outcome and secondly the loss of control vehicle would have had more time and distance to attempt recovery, in fact loss of control would not have occurred at 80 km/h.

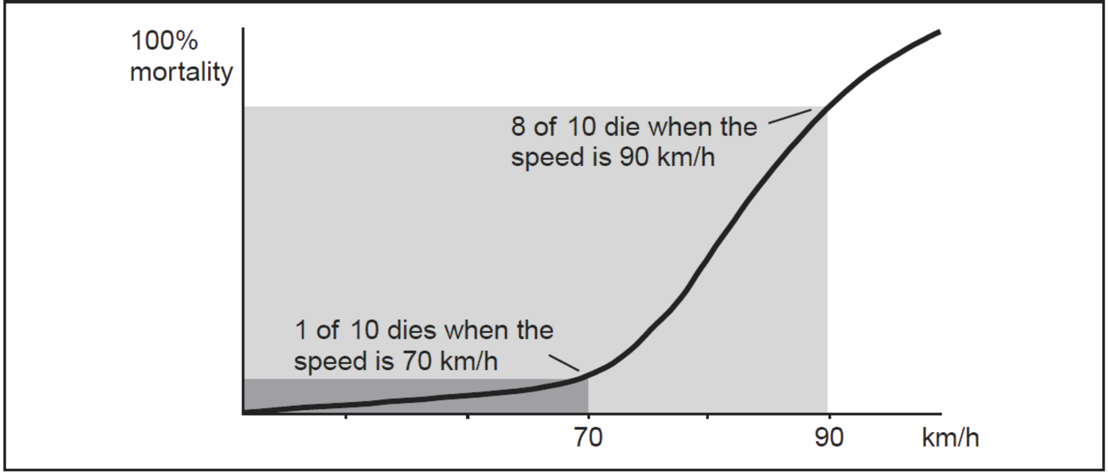


Plan of Crash Scene on Rural Undivided Highway

Research Probability of Death Relative to Speed in a Head On Crash

The following graph, Figure 2.1, extracted from Research of Wramborg 2005, shows the probability of death relative to speed in a head on crash.

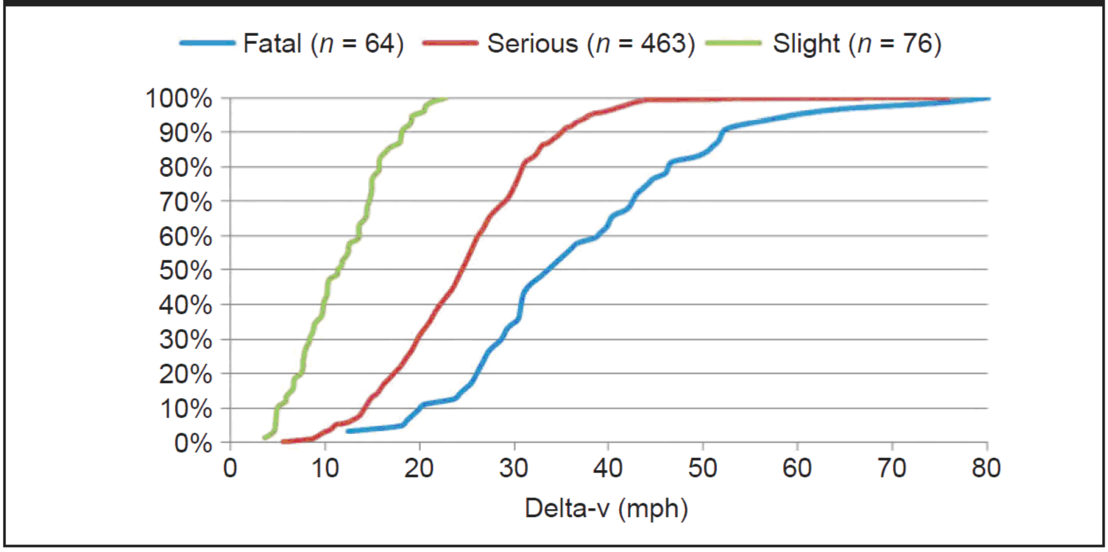
Figure 2.1: Probability of car driver/passenger fatality by head-on collision (Wramborg, 2005)



As can be seen from the above graph, 8 out of 10 car driver's or passenger's will probably die when the impact speed is 90 km/h, whereas only 1 out of 10 dies when the impact speed is 70 km/h. This data is consistent with outcomes I have found in reconstructing major collisions around the State of Victoria over the last 24 years.

Wramborg also produced risk curves relating to injury, serious injury or death in relation to speed change of the vehicle during impact, this is reproduced at Figure 3.1.

Figure 3.1: Cumulative speed curves for drivers in frontal impacts



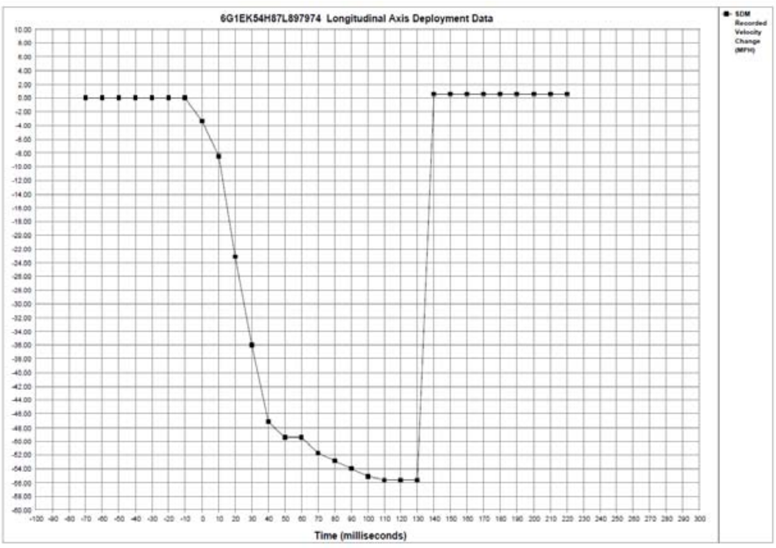
What can be seen from Figure 3.1 is that at a Delta V (Speed Change during impact) in a frontal impact 90% of driver's were fatally injured where the Delta V was 50 miles per hour or 80 km/h.

Case Study: Performance of 5 Star NCAP Rated Car in Head On Crash

The Major Collision Investigation Unit attended a two car, head on crash on a metropolitan freeway, where one car was travelling the wrong way down the freeway. Both driver's died in the crash. One of the vehicles involved was a very safe, 5 star rated, passenger car, that had crumple zones, energy absorbing steering wheel, seat belt pre-tensioners, frontal, side and side curtain airbags fitted. Crash Data (see below) was extracted from the vehicle that showed the 5 star rated car that was travelling down the wrong side of the freeway was travelling at 80 miles per hour (128 km/h) immediately prior to impact and had a 56 miles per hour (89 km/h) speed change during impact before moving past the point of collision post impact at 39 km/h and decelerating to a stop. The frontal airbags deployed on impact and the 40 year old, female driver was restrained. The seat belt pre-tensioners also deployed. The crash data retrieval in this case confirms research by Wramborg as the impact speed was greater than 90 km/h and the delta V was greater than 50 miles per hour, where the result was 90% of the time the outcome would be fatal.

Pre-Crash Data

Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Vehicle Speed (MPH)	79	79	79	80	80
Engine Speed (RPM)	1920	1920	1920	1920	1920
Accelerator Pedal Position (percent)	28	28	28	28	28
Percent Throttle	31	31	31	31	31
Brake Switch Circuit Status	OFF	OFF	OFF	OFF	OFF



Frontal Speed Change during impact, fatal outcome

Side Impact Crashes, 60 km/h versus 50 km/h

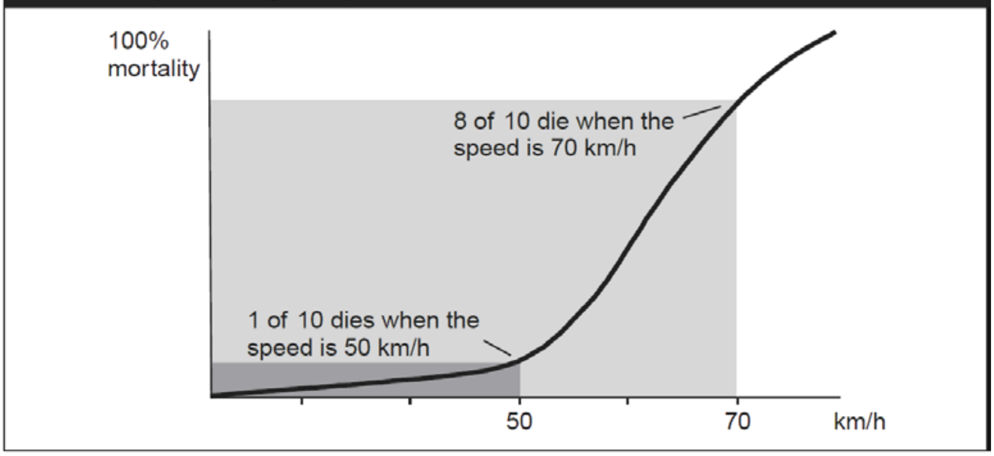
Numerous car to car collisions at intersections within metropolitan Melbourne have been reconstructed over the last 24 years. The results have shown that when the front of one car collides into the side passenger compartment of another car, an occupant who is seated on the struck side, undergoing a lateral speed change of about 30 km/h, without side airbag protection, the outcome is typically fatal. This situation would result if the bullet vehicle is of similar size and weight to the struck vehicle and is travelling at 60 km/h on impact, however if the bullet vehicles impact speed is 50 km/h reconstruction and vehicle side impact testing has shown that the resultant outcome is survivable. Australian New Car Assessment Program (ANCAP) testing replicates the outcome of the 50 km/h impact for the side impact collision an example of which is shown below:

ANCAP 50 km/h Side Impact Crash Test

Side Impact Research

The following graph, Figure 2.2, extracted from Research of Wramborg 2005, shows the probability of death relative to speed in a side impact crash.

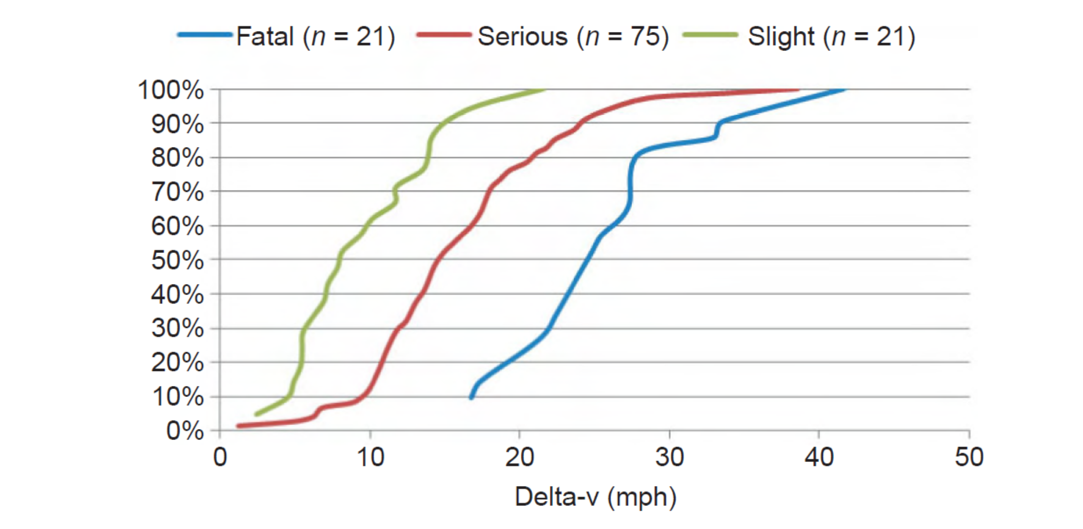
Figure 2.2: Probability of car driver/passenger fatality by side impact collision (Wramborg, 2005)



As can be seen from the above graph, 8 out of 10 car driver's or passenger's will probably die when the impact speed is 70 km/h, whereas only 1 out of 10 dies when the impact speed is 50 km/h. This data is consistent with outcomes from reconstructing major collisions in Victoria.

Wramborg's risk curves relating to injury, serious injury or death in relation to speed change of the vehicle during side impact, this is reproduced at Figure 3.3.

Figure 3.3: Cumulative speed curves for drivers in side impacts



What can be seen from Figure 3.3 is that where the Delta V in a side impact is greater than 25 miles per hour (40 km/h) at least 50% of driver's will be fatally injured.

With side impact air bags becoming more common in passenger cars reconstruction evidence is now showing that the lateral speed change before a fatal outcome occurs has gone up to 40 km/h to 45 km/h.

There still however exists large percentages of the passenger car fleet on the road that are not fitted with side impact airbags, in the near future this percentage will substantially reduce as a result of newly registered passenger cars in Victoria requiring fitment of side impact / curtain airbags and electronic stability control.

Vulnerable Road Users: Pedestrians & Cyclists

Victoria Police, Adult pedestrian head strike research conducted in 1999 of 32 fatal pedestrian collisions, showed that 19 occurred in 60 km/h speed zones. In all instances where the impact speed was 50 km/h upwards the outcome was fatal.

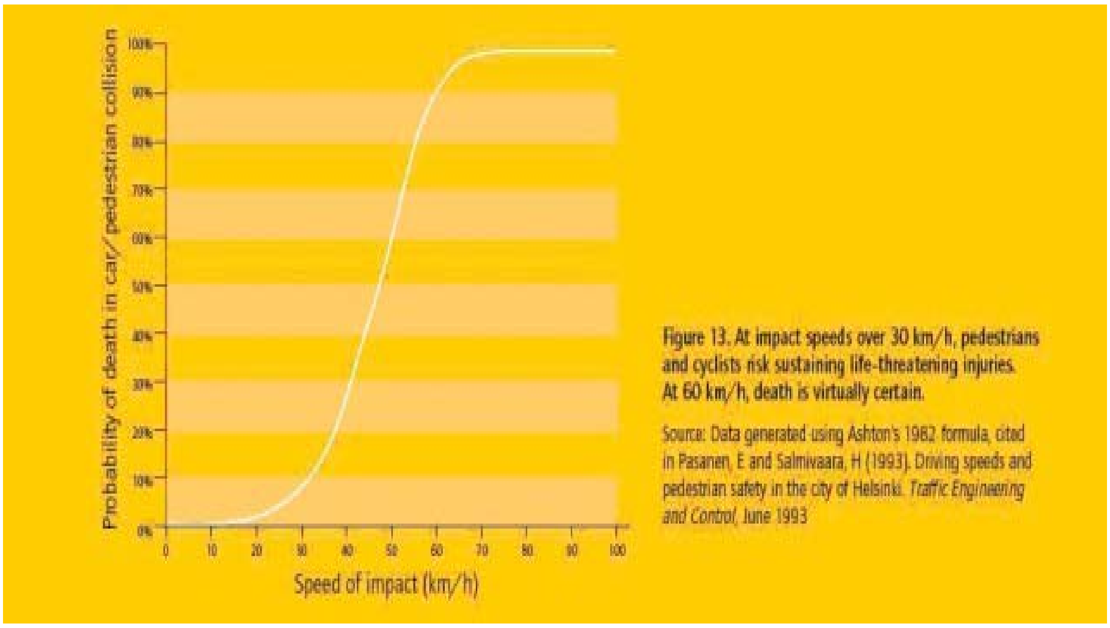
In relation to cyclist fatalities the most common fatal type collision that the Major Collision Investigation Unit attends is where a cyclist is struck from behind and the speed differential between the cyclist and the car is 30 km/h or more. For example if the bicyclist was travelling at 30 km/h and struck from behind by a car doing 60 km/h this is likely to result in a fatal outcome to the cyclist. Measurement of cyclists travel speed has shown that the average cyclist would be travelling at some where between

20 km/h to 30 km/h, so a fatal outcome could occur if the car was travelling at an impact speed of 50 km/h to 60 km/h.

In car video studies from Virginia in 2005 showed that 80% of crashes & 65% of near crashes involved driver inattention within 3 seconds prior to onset of conflict.

In Victoria the issue of distracted driving is on the increase. Victoria Police issued 35.550 infringements for mobile phone use is 2006 this increased to 55,969 in 2009, this data and the research from Virginia shows that driver distraction is a huge issue in Road Safety and in an environment where there are large volumes of pedestrians and cyclists such as the Melbourne Central Business District it is inevitable that the vulnerable road user will continue to get struck, what needs to happen is to bring vehicle travel speeds down to negate the fatal / life threatening outcome.

The following graph from data generated from Ashton 1982 and cited in Pasanen & Salmivaara (1993), Driving speeds and pedestrian safety in the city of Helsinki, *Traffic Engineering and Control, June 1993*, shows that at impact speeds over 30 km/h, pedestrians and cyclists risk sustaining life-threatening injuries. At 60 km/h death is virtually certain.



Graph Probability of Death in Car / Pedestrian Collision

Conclusions

Issues of safer vehicle speeds in regards to survivability has been discussed in relation to head on crashes on undivided rural roads with 100 km/h limits, 60 km/h metropolitan intersection crashes in regards to side impact and the Melbourne Central Business District with regards to Vulnerable road user survivability at speeds. Information has been presented from a practical point of view from a police officer with extensive crash reconstruction, enforcement and engineering expertise. The information has been supported by research.

Recommendations

It is recommended that the following should occur:

- Existing undivided rural roads that have speed limits of 100 km/h be reduced to 80 km/h.
- Metropolitan 60 km/h arterial roads where cross intersections are present be reduced to 50 km/h.
- Where an arterial road also has an on road painted bicycle path or has high volumes of bicycle traffic present the speed limit should be no more than 50 km/h.
- In the Melbourne Central Business District the speed limit should be no more than 40 km/h.
- Shopping strips or roads where school children regularly cross have no more than a 40 km/h limit, including arterial roads that are not on a boundary of a school.

If these safer speeds were introduced it would have a substantial effect on reducing road trauma further in Victoria.

References

1. The Relationship between Speed and Car Driver Injury Severity, D. Richards and R. Cuerden Transport Research Laboratory, April 2009, Department for Transport: London.

2. Driving speeds and pedestrian safety in the City of Helsinki, E. Pasanen and H. Salmivaara, June1993, Traffic Engineering and Control.

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6. Victoria Police Enforcement Data, Traffic Camera Office, Intelligence Unit, 2006 and 2009.

7. Australian New Car Assessment Program, Side Impact Crash Test Data.