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Post impact travel and secondary impacts following urban intersection collisions

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Abstract

This paper describes the path of vehicles following a collision with another vehicle at a metropolitan intersection. The aim was to provide guidance to transport authorities on roadside design at intersections to protect vehicles from secondary collisions with roadside objects. Detailed information from in-depth investigations of 78 intersection crashes were analysed. Crashes at signalised and unsignalised intersections were analysed separately. Secondary collisions with roadside objects were identified with 16 signalised and 16 unsignalised intersection cases. Nine of these 32 collisions were more severe than the initial vehicle-to-vehicle collision, three at signalised intersections and six at unsignalised intersections. Of the 78 intersection crashes, more than half of the vehicles came to rest within 10 metres of the impact point. More than a quarter travelled 15 metres or further and approximately 10% travelled further than 27 metres. It was found that 28 of the 70 crash involved vehicles at signalised intersections encroached into the designated pedestrian crossing areas. It was also found that 10 of those vehicles departed the roadway. The study has indicated the most likely locations that vehicles will traverse following collisions at urban intersections. This information can be used by road designers to make decisions in relation to the protection or removal of roadside objects in the vicinity of intersections.

Extended Abstract

This report describes the paths of vehicles following a collision with another vehicle at a metropolitan intersection. The aim was to provide information to transport authorities that would assist in roadside design at intersections to protect vehicles from secondary impacts with roadside objects. This research was prompted by observations from CASR's in-depth crash investigations that secondary impacts with roadside hazards often occurred following a primary impact with another vehicle, and that the secondary impact was sometimes found to be more severe than the initial vehicle-to-vehicle collision. This project was complemented by an earlier study by the authors that investigated post impact trajectories of vehicles at rural intersections (Doecke, Woolley and Mackenzie, 2011).

There appears to have been limited research on this topic. The majority of research into intersection crashes focused on the pre-crash movements of the vehicles rather than the movement of vehicles after an initial impact. The only study identified that made reference to post impact trajectory of vehicles following an intersection crash found that 15 vehicles from a sample of 35 uncontrolled intersection crashes struck a roadside object after the initial collision (McLean et al, 1979).

Intersection crashes made up 23.5% of all crashes in South Australia over the past 10 years. When collisions between two motor vehicles (excluding motorcycles) were considered, approximately 40% of crashes occurred at intersections controlled by traffic signals and 40% at intersections with no traffic control. The remainder occurred at intersections with give way or stop control. (Table 1).

**Table 1. South Australian crash statistics related to intersections, 2002 to 2011
(excluding single vehicle, motorcycle, and pedestrian crashes)**

	All		All Injury		Serious Injury		Fatal	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Total crashes	196,940	100%	51,301	100%	5,938	100%	470	100%
Intersection	46,198	23.5%	11,341	22.1%	1,140	19.2%	83	17.7%
Intersections by Traffic Control Type								
Uncontrolled	17,592	38.1%	3,879	38.1%	339	29.7%	31	37.3%
Give way	4,978	10.8%	1,294	10.8%	153	13.4%	17	20.5%
Stop	4,997	10.8%	1,318	10.8%	134	11.8%	12	14.5%
Signalised	18,631	40.3%	4,850	40.3%	514	45.1%	23	27.7%

* All Injury includes all individuals treated by a doctor, treated at hospital, admitted to hospital and fatal. Serious Injury includes all individuals admitted to hospital or fatally injured

Detailed information concerning metropolitan intersection crashes was obtained from the Centre for Automotive Research's (CASR) in-depth crash investigation database. Metropolitan road crashes were investigated by CASR during two separate time periods; 2002 to 2005 and 2009 to 2012. For this study, crashes involving a vehicle-to-vehicle collision at a metropolitan intersection were identified from both time periods. To simplify the analysis, rear end crashes at intersections were excluded, as were crashes involving motorcyclists, cyclists and pedestrians. In total, 64 intersection crashes were obtained from the period of 2002 to 2005, and 14 intersection crashes were obtained from the period of 2009 to 2012.

The results of crashes that occurred at signalised intersections and unsignalised intersections were analysed and presented separately as it was thought that there would be fundamental differences between the two. There were 35 signalised and 43 unsignalised intersection crashes in the sample. Sixteen of the 70 vehicles involved in the signalised intersection crashes were involved in a secondary collision, most commonly with traffic signal pole or a stationary vehicle. Similarly, 16 of the 86 vehicles involved in unsignalised intersection crashes were involved in a secondary collision. Objects struck in these collisions included trees, fences, signs and electricity poles. Nine of these collisions were more severe than the initial vehicle-to-vehicle collision, three at signalised intersections and six at unsignalised intersections.

Following the 35 vehicle-to-vehicle impacts at a signalised intersection, more than half of the vehicles came to rest within 10 metres of the impact point. However, more than a quarter travelled 15 metres or further and 9% travelled further than 27 metres.

When unsignalised intersections were investigated, approximately half of the vehicles came to rest within 10 metres of the impact point. However, 30% travelled 15 metres or further and 10% travelled further than 27 metres from the impact point.

Of the 70 vehicles involved in crashes at signalised intersections, 28 encroached into the designated pedestrian crossing areas. It was also found that 10 of the 70 vehicles departed the roadway. When considering unsignalised intersections, 23 of the 86 vehicles left the road. This study has indicated the most likely paths that vehicles will traverse following collisions at urban intersections. This information can be used by road designers to make decisions in relation to the protection or removal of roadside objects in the vicinity of intersections.

References

Mclean AJ, Offler WJ, Sandow BL (1979). Adelaide in-depth accident study 1975 – 1979. Part 7: road and traffic factors. Adelaide: Road Accident Research Unit, The University of Adelaide.