Safety on Congested Urban Motorways

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Abstract

The metropolitan Melbourne motorway network carries 40 per cent of urban arterial road travel and casualty crash numbers have been increasing despite a decreasing trend on other urban roads. Infrastructure is rarely mentioned in Police crash reports as being involved in the urban motorway crashes, rather mention is made about traffic conditions and vehicle-to-vehicle interactions. Analysis was undertaken to test the hypothesis that the dynamic of the traffic flow, which causes congestion and requires complex driver responses, is a significant component of the casualty crash problem. A relationship between 'traffic state' and crashes was observed.

Background

The metropolitan Melbourne motorway network represents seven per cent of the urban arterial road network yet it carries 40 per cent of the urban arterial road travel in terms of vehicle kilometres travelled and this percentage is growing. The number of casualty crashes on metropolitan Melbourne motorways has increased by 15 per cent over the last 10 years (2008 to 2017) despite an overall decrease of 15 per cent in the total number of urban casualty crashes over the same period.

The majority of urban motorway casualty crashes are vehicle-to-vehicle crashes, with rear-end crashes accounting for 53 per cent of the crashes and lane change or side swipe crashes accounting for 18 per cent of crashes. Run off road crashes only account for 15 per cent of the crashes. The Police reports discuss heavy and/or stop-start traffic and vehicle blind spots as contributing factors to the crash and rarely mention infrastructure.

As urban motorways are generally built to the highest standards, a new way of looking at motorway safety is required. This led to the formulation of a hypothesis that the dynamic of the traffic flow, which causes congestion and requires complex driver responses, is a significant component of casualty crashes on urban motorways.

There is overwhelming evidence that the dynamic of the traffic flow requires significant changes to driver behaviour, contributing to increasing number of crashes. Golob, Recker and Alvarez (2004) identified adverse safety effects of congested motorways and increased crash rate under flow breakdown conditions. Kononov, Bailey and Allery (2008) conclude that although crashes increase moderately with increased traffic on uncongested segments, once a critical density is reached crashes increase at a faster rate.

Method

In-depth analysis was undertaken for the Monash Freeway and Eastern Freeway. Crash data was linked to traffic data including vehicle occupancy (a measure of density), vehicle speed and flow. Vehicle occupancy was used to categorise the 'traffic states' ranging from free-flow to flow breakdown.

Results

A relationship was observed between crash occurrence and 'traffic state'. Nearly half (45%) of the weekday casualty crashes on the Monash Freeway occurred in conditions where flow breakdown (congestion) has occurred (31%) or where flow breakdown is likely or certain to occur (14%), however only eight per cent of the day operates at conditions corresponding to flow breakdown and five per cent of the day operates at conditions where flow breakdown is likely or certain to occur. Considering exposure, only 19 per cent of the total day's traffic occurs in flow breakdown conditions and only 10 per cent of the total day's traffic occurs in conditions where flow breakdown is likely or certain to occur (see figure below).

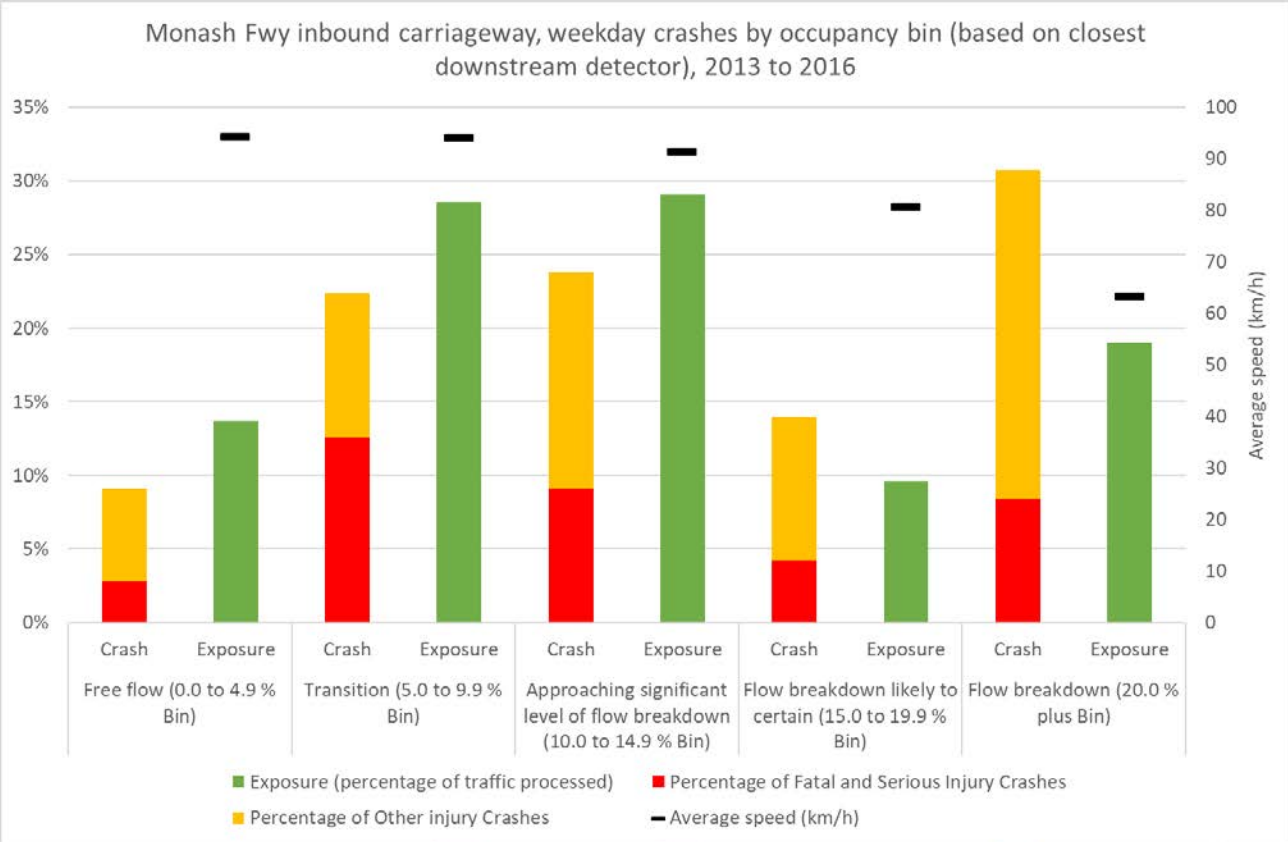

Figure 1. Comparison of Monash Freeway crashes and traffic state

Conclusion

There is a relationship between crash occurrence on urban motorways and the traffic state. The results of this analysis can be used to improve safety on urban motorways through the development of Intelligent Transport System strategies to keep the motorway operating at conditions that minimise flow breakdown risk.

References

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