

# Motorcycles on Motorways

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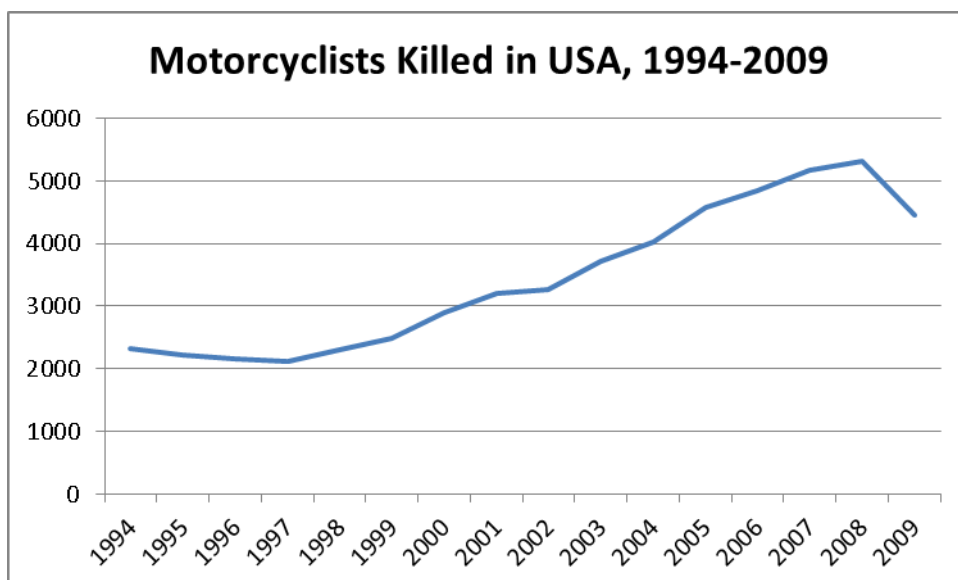
## ABSTRACT

After a significant reduction in motorcycle mode share through the 1980's and 2000's, over the last few years there has been a noticeable upswing in motorcycle usage. This trend has been observed throughout the developing world as born-again motorcyclists get back on their bikes. Given that motorcyclists have the highest crash risk of all modes of travel, with crash rates many times higher than that of cars, this is leading to increasing crash rates and is likely to continue to increase if intervention does not occur. Given this concern the Government have signalled in the Safer Journeys road safety strategy that motorcycle safety is a main road safety focus going forward. The Government is looking to follow the lead of Victoria in Australia which has developed and implemented road safety blackspot programs focused on motorcycle crashes. In this technical note, we consider the increased risks that increasing motorcycle volumes may have on the Auckland motorway network and how this can be mitigated.

The Auckland Motorways Motorcycle Safety Strategy has been developed by the Auckland Motorway Alliance to manage and reduce the motorcycle crash risk on the Auckland Motorways. This technical note will discuss the key elements of the strategy, including motorcycle crash trends on the Auckland Motorways, regionally and nationally. Based on the strategy undertaken, there is anecdotal evidence to suggest that the risk of motorcycle severe injury crashes on Auckland Motorways could be twice as high when compared to the region and the rest of the country. Other factors such as types of objects struck, age groups and motorcycle engine size will also be discussed. Concerns expressed by the motorcycling groups will also be reported and presented. This technical note will discuss the strategies of improvements in areas of engineering, enforcement, education and evaluation that the Auckland Motorway Alliance will strive to achieve. Finally, this technical note will also discuss the potential difficulties and obstacles to improve motorcycle road safety, such as motorcycle data collection and route selection for improvement works.

## INTRODUCTION

Motorcycling is an inherently risky activity in comparison to other modes of transport. The New Zealand Travel Survey (2003-2008 data) estimated that, for the same distance travelled, motorcyclists were 16 times more likely than a car driver to be killed or seriously injured in a traffic crash. The number of motorcyclists killed or seriously injured in New Zealand declined steeply during the 1990s but has increased since 2005. The increase in motorcyclists killed or seriously injured is consistent with the trends observed in other developing and developed countries. In the United States of America for example, the number of motorcyclists killed have increased since 1997, with a decrease recorded in 2009.



**Figure 1 Motorcyclists Killed in USA (1994-2009)**

Source: National Highway Traffic Safety Administration Data Resource Website

The percentage of motorcycle fatalities in New Zealand is reported to be 13.7% (OECD-International Transport Forum, 2010). This level is similar to other countries in the OECD such as Australia (17.0%), Ireland (11.3%) and the Netherlands (21.4%).

The Auckland Motorways Motorcycle Safety Strategy has been developed by the Auckland Motorway Alliance to manage and reduce the motorcycle risk on the Auckland Motorways. This technical note presents the key elements of the strategy, including the motorcycle crash trends on the Auckland Motorway, regionally and nationally. Based on the strategy undertaken, there is anecdotal evidence to suggest that the risk of motorcycle severe injury crashes on Auckland Motorways could be twice as high when compared to the region and the rest of the country. This strategy details the review of motorcycle crash trends over the past ten years on the Auckland Motorway Alliance (AMA) network with the following objectives:

- to understand motorcycle crash patterns (e.g. crash types and crash locations);
- to identify crash clusters and common crash types for treatment (i.e. blackspot and mass action programs); and
- to identify possible motorcycle safety measures that could be implemented on the AMA network. While the measures are likely to focus on physical roading improvements, the study will also recommend any legislative changes that would be worthwhile, some of which may already be signalled in the Safer Journeys national strategy.

## MOTORCYCLE OWNERSHIP TRENDS

The numbers of licensed motorcycles in the Auckland region have increased in recent years. Based on the licensed motorcycle statistics from New Zealand Transport Agency (NZTA), the mode share of motorcycles in Auckland Region has increased from 1.2% in 2005 to 1.6% in 2008. This corresponds to an average increase of 15% per year for the motorcycles, compared to an average of 2% for all vehicles (refer Table 1).

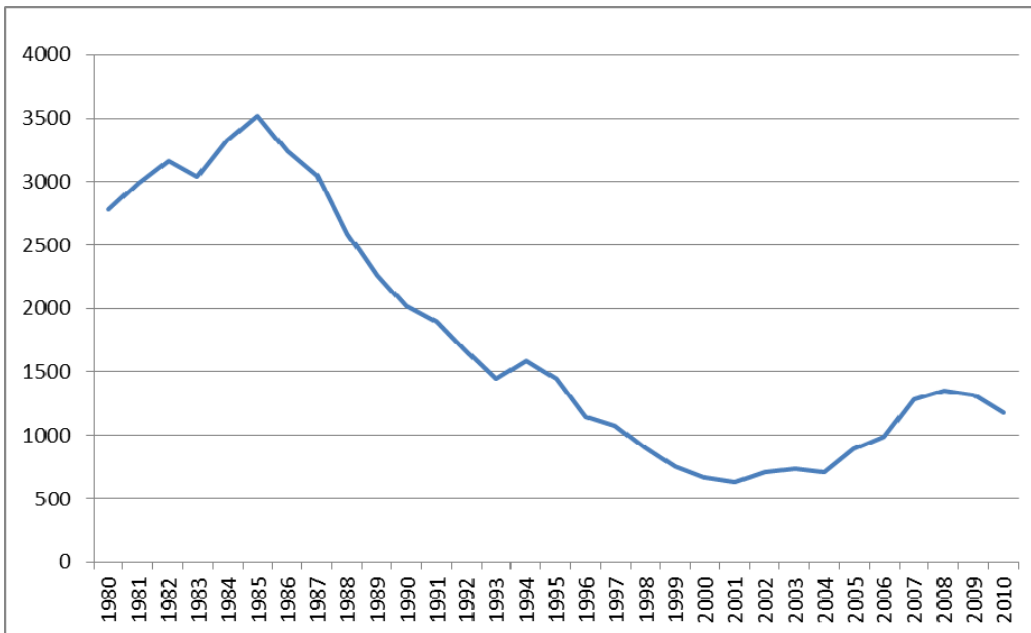
**Table 1 Licensed vehicles in Auckland Region (New Zealand Transport Agency, 2008)**

Year	Licensed motorcycles	Annual Growth (%)	Licensed vehicles	Annual Growth (%)
2005	11,671	-	985,307	-
2006	13,254	13.6%	1,005,709	2.1%
2007	15,156	14.4%	1,032,609	2.7%
2008	16,952	11.9%	1,047,652	1.5%

While the statistics have indicated that 1.6% of total licensed vehicles are motorcycles, the levels of motorcycling were expected to be lower on the Auckland Motorways. This is because the statistics have included mopeds and low-powered motorcycles that are either not allowed on the motorways or less inclined to ride on the network due to differential speed issues with other traffic.

## MOTORCYCLE CRASH TRENDS

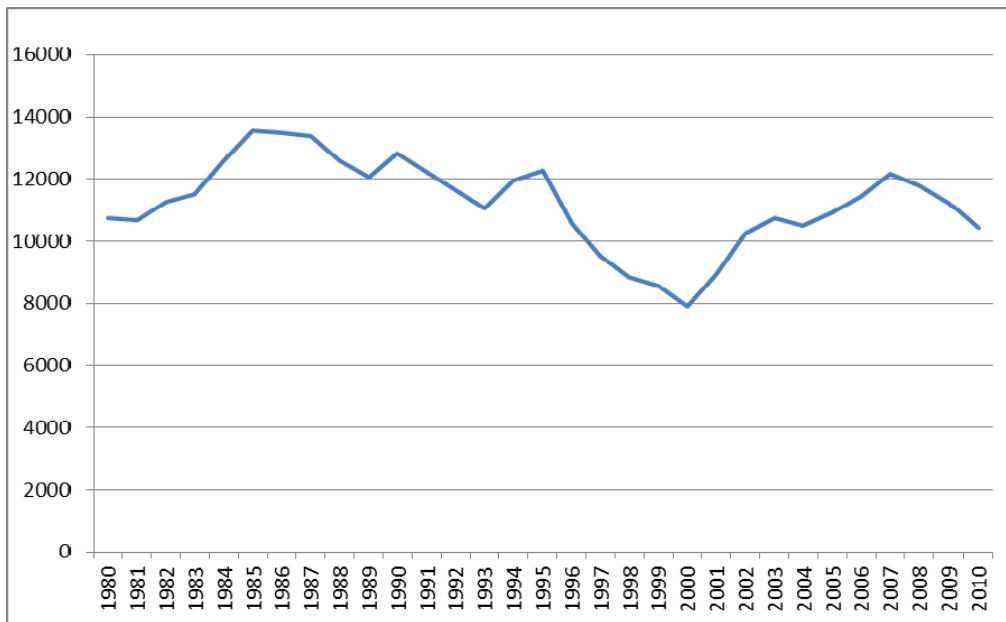
The number of motorcyclists killed or seriously injured in New Zealand declined steeply during the 1990s. The decrease plateaued around 2000 but has started increasing since 2005 (Refer Figure 2).



**Figure 2 Motorcyclists Killed and Injured in New Zealand (1980-2010)**

Extracted from NZ Transport Agency Crash Analysis System (CAS) database

The motorcycle injury crash trend is somewhat similar to the trend of vehicle injury crash trends (Refer Figure 3), where there was a decreasing trend between late 1980s and 2000 but with increasing trend since 2000.



**Figure 3 Vehicle Injury Crashes in New Zealand (1980 - 2010)**

Extracted from NZ Transport Agency Crash Analysis System (CAS) database

The decline in the number of motorcyclists killed and injured from the mid-1980s to 2000 may be attributed to:

- Various road safety initiatives and programs such as crash reduction studies and road safety audits;
- Multi-stage graduate driver licensing program introduced in August 1987;
- Increased police enforcement;
- Television road safety related advertising campaigns; and
- Marked decrease in popularity of motorcycling. Between 1989/1990 and 1997/1998, motorcycle ownership fell by 40% and total distance ridden fell by almost as much .

The increase in the number of motorcyclists killed and injured in recent years is likely due to the increase in popularity of motorcycling (refer Table 1). This in part may be attributed to recent increase in fuel prices and/or congestion in major cities here in New Zealand causing a mode shift towards motorcycling.

## MOTORCYCLE GROUPS DISCUSSION

Motorcycle safety was discussed in the formal 2010 AMA Crash Reduction Studies, with participants from motorcycle groups, NZTA, AMA and Beca. The motorcycle groups involved included Biker's Rights Organisation of NZ (BRONZ) and Ulysses. The motorcycle safety discussion included motorcyclist behaviour, general roading and AMA specific motorcycle safety issues, which are summarised below.

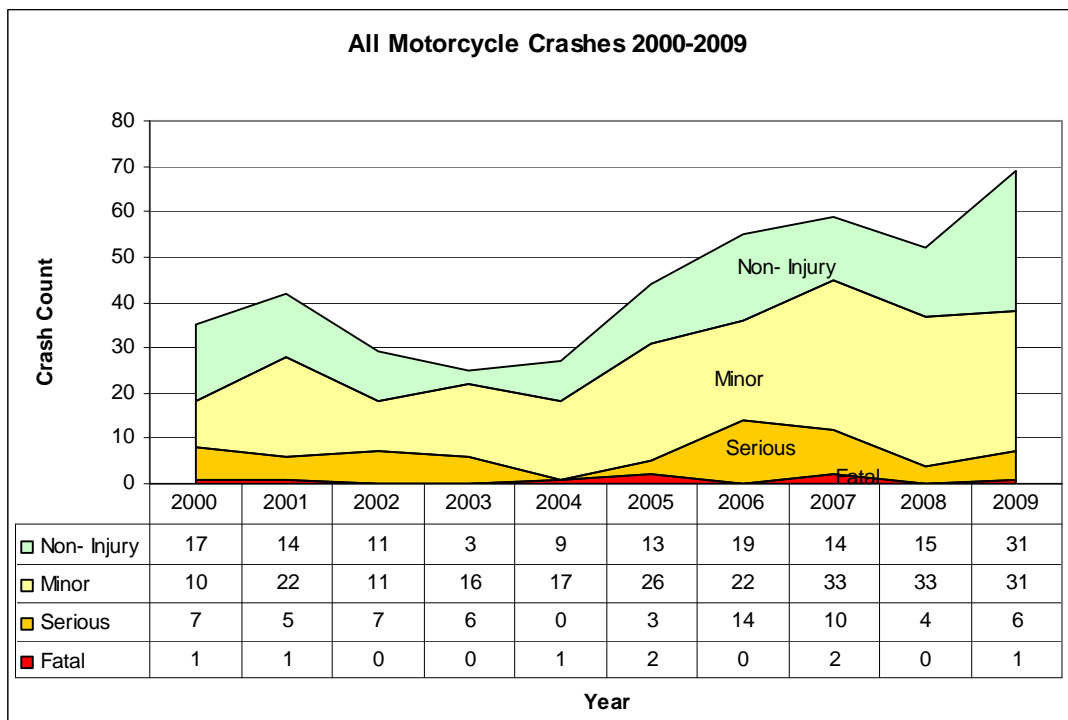
- Direction and strength of wind is an important factor for both non-experienced and experienced riders.
- The Auckland Harbour Bridge flags act as wind socks and deemed to be useful for riders as they are able to judge the direction and strength of wind at the bridge.
- Educational campaigns were expressed to be of importance for novice riders as most riding skills are learnt from experience.
- Motorcyclists are strong networkers and this networking can be used as an effective tool for educational campaigns.
- An important driver behaviour noted is that motorcyclists are more inclined to avoid the hazard in front them rather than apply brakes as car users do. Novice drivers do not feel comfortable in wet conditions and therefore prefer to avoid riding in wet conditions.
- Lane splitting is used by motorcyclists to avoid long queues. Lane splitting is the act of riding a motorcycle on/near the lane line between two lanes of vehicles. This is tolerated by

the NZ Police on the Auckland Motorway Network with the condition that the motorcyclist is riding within 20km/hr above the operating speed.

- To ensure visibility to car users, motorcyclists will often ride on the right hand side of the lane to be in line with car drivers.
- The two most important factors for motorcyclist are visibility of roading environment and road surface quality. Motorcyclists can find multiple traffic signs to be information overload.
- The worst situation for a motorcyclist is to be in a queue at dark. This is due to reduced visibility in the dark and difficulty of stop/start operation (maintaining balance) at slow speeds.
- It is compulsory by law to have headlights on at all times. Motorcycles are only allowed to have one headlight operating at any time.
- Representatives guesstimated that 60%-70% of the motorcyclists are novices (with less than three years of riding experience).
- Bitumen flushing reduces skid resistance for riders.
- Loose gravel: Representatives have expressed concern regarding loose chips not being properly cleared at work site live lanes which have led to motorcycle crashes e.g. SH22.
- Motorcyclists avoid white lines due to reduced skid resistance and during wet conditions visibility of white lines are reduced which makes it difficult for motorcyclists to ride.
- As motorcyclists prefer to dodge hazards, reduced roadside furniture is recommended to allow motorcyclists to perform the manoeuvre. Clear zones are required at areas of high motorcycle crashes.
- Representatives consider the right hand side of the right lane to be the safest position on the road to be in. This is due to clearer visibility of merging manoeuvres of vehicles. Thus motorcyclists prefer consistent shoulder width on the right hand side of the outer lane to provide greater manoeuvrability and safety.
- Manholes on motorways have been suggested to be covered with high skid resistance chips to increase comfort in riding and visibility.
- Domes (used occasionally as lane lines on the motorway) are an issue for inexperienced motorcyclists as they are unsure if the markings are skid resistant. Public education campaigns were suggested for new road markings.
- Motorcyclists prefer vegetation by side of the road as it reduces the impact upon collision.
- Ramp Signals make it difficult for motorcyclists due to the stop/start operation style. Motorcycles are more unstable (keeping balance) at low speed and the engine increases in temperature relatively quickly which can make it very uncomfortable for the rider.

## AMA MOTORCYCLE CRASH TRENDS

The number of crashes involving a motorcycle over the last ten year period is plotted in Figure 4. As shown in this figure, the motorcycle crash trend on the AMA network is quite similar to the trend shown in Figure 2, where motorcycle injury crashes are showing signs of increase since 2004. Due to the low number of motorcycle crashes reported on the non-motorway sections of AMA network, the motorcycle crashes on these sections have not been analysed separately, despite having lower speed limits in some cases.



**Figure 4 Motorcycle Crashes on the AMA network (2000-2009)**

Between 2000 and 2009, there were a total of 437 motorcycle crashes reported on the AMA network. There were eight fatal and 62 serious injury motorcycle crashes reported, representing 13% of all severe injury crashes (fatal and serious injury) reported on the AMA network. In comparison, severe injury motorcycle crashes represented 14% and 15% of all severe motorcycle injury crashes reported in the Auckland region and entire New Zealand respectively.

To understand the relative risk for motorcyclists on the Auckland Motorways network, it is imperative that the level of motorcycling on the Auckland Motorways network be quantified. The quantification of motorcycles passing the Automated Traffic Management Systems (ATMS) could underestimate numbers as motorcyclists do not necessarily ride over the loops in the centre of the lane. Furthermore, differentiation between motorcycles and light vehicles could not be made from the ATMS loop data. To measure levels of motorcycling, video recordings taken by the AMA from multiple locations on the motorway network at various times have been examined. Based on the limited data available, motorcycles were found to be approximately 0.8% of all vehicles on the network. This implies that approximately half the licensed motorcycles in the Auckland region use the motorways<sup>1</sup>.

Other factors were also investigated and the main findings are:

- Motorcycle crashes on the AMA network are mainly made up of loss of control, rear end and lane changing movements, with crossing/turning crashes highly represented in the fatal and serious injury crashes.
- Guardrails and barriers are the most commonly struck objects. All three fatal crashes into objects involved striking guardrails and barriers. A high proportion of other severe injury motorcycle crashes also involved guardrails and barriers, which implies that although guardrails/barriers may have reduced the number of severe injury crashes into hazards which are inherently more risky than the guardrails/barriers itself, they still carry residual risks to the motorists.

<sup>1</sup> Assuming that the percentage of motorcycles on other roads corresponds to the percentage of licensed motorcycles in the region.

- Motorcycle crashes are generally reported most frequently in peak periods but with increasing numbers reported during inter-peak period in the last two years. Severe injury crashes are mainly reported during the afternoon and evening periods.
- Severe injury crashes (fatal and serious) are mainly reported in dark conditions.
- Motorcycles below 650cc rating are increasingly involved in crashes since 2003, coinciding with the increase of motorcycle crashes involving the youngest age group (17-25) within the same period<sup>2</sup>.
- Influence of alcohol/drugs and speed each contributes towards higher risk in more severe injury crashes.

## RECOMMENDATIONS

The vision signalled in Government's Safer Journeys is to achieve a safe road system increasingly free of death and serious injury through a Safe System approach to road safety. The Safe System focuses on creating safe roads, safe speeds, safe vehicles and safe road use. To achieve a Safe System for motorcycle safety on the AMA network, the recommended measures were made for the four E's of road safety, namely through engineering, enforcement, education and evaluation.

The principles of the four E's could be briefly summarised as:

- **Engineering:** Focused at improving the safety of motorcyclists through the upgrade and/or improvements to the existing and new infrastructure.
- **Enforcement:** The act of enforcing a set of rules, principles or laws. Law enforcement could be targeted at specific motorcyclist behaviours that have been shown to contribute to crashes.
- **Education:** Any act or experience that has a formative effect on the mind of an individual. May include campaigns aiming at specific behaviours identified as contributing factors towards the motorcycle crashes on the AMA network.
- **Evaluation:** Systematic determination of merit, worth, and significance of something using criteria against a set of standards. This may include developing or establishing a monitoring process for motorcycling activities and crash trends.

Based on the AMA Motorcycle Safety Strategy, it was recommended that:

### Engineering

1. Routes with a history of motorcycle crashes be treated through broad mass action programmes within crash reduction studies. This shall be included in the 2011 AMA Crash Reduction Studies. It is recommended that motorcycle crash reduction studies be broadened to include proactive approaches (such as conducting road safety audit in parallel or prior to the Crash Reduction Studies).
2. An investigation on provisions for wind-socks or variable message signs to indicate conditions that may present a risk to motorcyclists be undertaken.
3. AMA establish a programme to:
  - Ensure that loose gravel at/from work sites are properly cleared;
  - Replace the paint markings that have poor wet skid resistance and domes (used as lane lines) with high traction marking materials.
  - Address manhole covers/lids on motorways (such as northbound section between Ellerslie-Panmure Highway Interchange and Greenlane Interchange) with high friction materials or with proprietary products such as Wunder manhole lids.
  - 'Ghost' line markings (left behind from line marking removals) which are aligned at an angle to the direction of travel tend to cause different relative traction forces and hence create a risk to motorcyclists, particularly when combined with dark/wet conditions. It is recommended that these angled markings be temporarily treated with materials with closer traction properties compared to the adjacent pavement (such as proprietary marking tapes).
  - Treat bridge joints with high friction epoxy.
  - Treat gouges caused by vehicle incidents (such as crashes) on the pavement. The bigger

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<sup>2</sup> Established based on sample data using single motorcycle crash data

gouges are currently filled with asphalt, but further investigations and lab testing would be required to determine the course of action required to treat smaller gouges which would present a safety risk to motorcyclists. It is recommended that the smaller gouges on the whole of the network be determined periodically such that further to-be-identified actions could be implemented.

#### Enforcement

4. The investigation of point-to-point speed enforcement be further progressed to target speed related motorcycle crashes;
5. Continued police enforcement to target speed and alcohol related offences. Through the recommended incorporation of motorcycle crashes in the annual CRS, the AMA shall also provide information on where the areas at risk of speeding and alcohol involvement are.

#### Education

6. Funding opportunities for behavioural campaigns and advertisements dealing with motorway specific issues be explored. Specific motorcycle safety issues to be targeted include:
  - Travelling at safe speeds and following distances;
  - Risk of drink driving/riding;
  - Lane splitting between stopped/slow vehicles and narrowed lanes
  - Motorcyclist awareness of high visibility and appropriate motorcycling clothing and accessories.
7. Campaigns and advertisement possibilities that require further investigations are billboards or signs, message on small meaningful gifts through local motorcycling clubs (targeting returning riders), or for younger riders, possibly through the internet (YouTube, Facebook, etc).

#### Evaluation

8. Motorcycle Crash Reduction Studies be undertaken as part of the AMA Annual Crash Reduction Studies.
9. Annual motorcycle count surveys be undertaken at pre-determined locations on the AMA network to establish motorcycling demand, flow profile and growth.

## **CONCLUSIONS**

From the AMA study, it was found that the percentage of motorcycle crashes on the AMA network to be very similar to the rest of the region and country. The risk of severe injury could however be twice as high due to lower levels of motorcycling recorded on the AMA network. The increasing motorcycle crash trend on the AMA network was also found to be consistent with the national and international trends. That study also investigated the motorcycle crash factors on the AMA network and based on the main findings, measures aimed at either reducing the likelihood of motorcycle crashes or reducing the severity of motorcycle crashes that occur, or both, were recommended for the four E's of road safety (engineering, enforcement, education and evaluation).

## **REFERENCES**

National Highway Traffic Safety Administration Data Resource Website.

<http://www-fars.nhtsa.dot.gov/Trends/TrendsGeneral.aspx>

New Zealand Transport Agency (2009), New Zealand Motor Vehicle Registration Statistics (2005 - 2008).

<http://www.nzta.govt.nz/resources/motor-vehicle-registration-statistics/docs/2008.pdf>

OECD-International Transport Forum (2010), IRTAD Database June 2010 – Fatalities by road use.

<http://www.internationaltransportforum.org/irtad/pdf/roaduse.pdf>