

Connected Roads – Enabling tomorrow’s technologies today

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Abstract

The typical road infrastructure consists of visual cues, as human drivers predominately use their vision to navigate around and drive their vehicles on the road. In a similar manner, most advanced vehicles today -as well as the ones currently designed for the future- also rely on cameras and sensors that help the vehicle ‘see’ the world around it. Human drivers will most likely co-exist with Connected Autonomous Vehicles on the roads for many years to come, possibly decades. This paper will look at the importance of designing road markings today for both types of drivers of tomorrow.

Background

There has been plenty of research around the human vision and how bright traffic signs, pavement markings and other traffic cues need to be to adequately stimulate the brain and create an appropriate response from the driver so they can safely navigate the roads at day or night and under most conditions.

The main problem in doing the same thing for Connected Autonomous Vehicles is fragmentation. Fragmentation between vehicle manufacturers, camera manufacturers, technologies, country Standards etc. Various bodies have already been formed on a global scale to help tackle this, but as with anything new it will take some time before things start to settle.

As vehicle manufacturers work in improving the capabilities of their vehicles on the roads by utilizing newer and more accurate sensors, smarter programming and various types of Artificial Intelligence the various Road Authorities can also assist with the integration by upgrading their traffic infrastructure.

To overcome the differences between how humans and machines ‘see’ and perceive the world a hybrid solution is required to accommodate both types of drivers; a type of infrastructure that is visible and understandable by humans as well as machines, is cost effective, easy to maintain and readily deployable.

The importance of Pavement Markings for all types of drivers

When it comes to the human element the numbers are clear. Although most crashes happen during the day, most deadly accidents occur at night with poor road markings being a major contributor. ^{2}

A particularly disturbing statistic when looking at deaths from common crashes on the roads, the one that consistently stands out in Australia -by a large margin- is the ‘Single vehicle run-off road’ (2008-2015). ^{1}

The relationship between brightness in pavement markings and crash reduction can be seen in the figure below (Paul J. Carlson, Raul E. Avelar, Eun Sug Park & Dong Hun Kang, 2015)

Brighter Pavement Markings Reduce Crashes

Nighttime Safety and Pavement Marking Retroreflectivity on Two-Lane Highways: Revisited with North Carolina Data

Paul J. Carlson, Raul E. Avelar, Eun Sug Park, Dong Hun Kang. Texas A&M Transportation Institute.

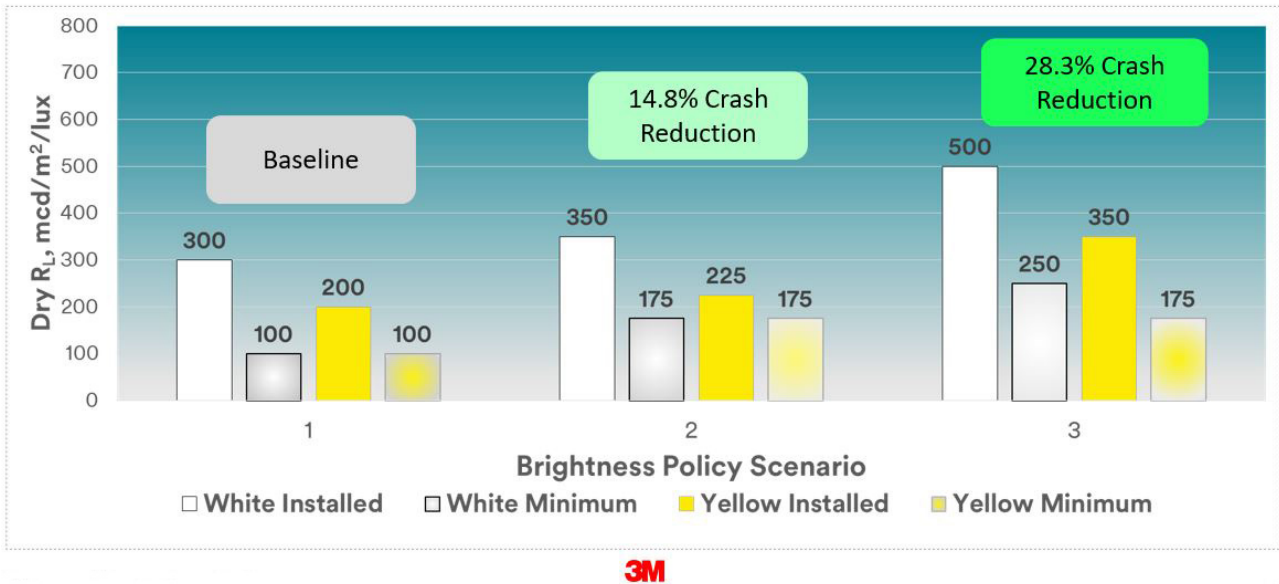


Figure 1. Pavement marking brightness vs crash reductions

In a similar manner, road markings are proving to be just as important for vehicles. A recent study by ARRB to test and better understand the Driver Assistance Systems on a multitude of modern vehicles found that “line markings ARE IMPORTANT”. (ARRB, 2018, Connected and Automated Vehicle Trials, Austroads Webinar).

Whilst the design and performance parameters of those markings is currently being explored by various companies and industry experts, a common pattern seems to emerge.

Pavement Marking features for optimal machine reading (detect and register):

- Day-time visibility: **High luminance contrast ratio**
- Night-time visibility: **High retroreflectivity**
- Dry vs Wet scenarios: **Wet recovery**, Mixture of **dry & wet retroreflective elements**
- All scenarios: **Wider lines**

Discussion

To achieve the ultimate goal of eliminating crashes, injuries and deaths Connected and Autonomous Vehicles need to be able to safely navigate our road networks and for that to happen all parties in the industry need to work together. The sheer number of competitors as well as the speed that the technology advances means that a small fragmentation in the industry is probably unavoidable, possibly leading to the development of more than one Standards globally.

References

- {1} Bureau of Infrastructure, Transport and Regional Economics (BITRE), 2017, Road trauma Australia 2016 statistical summary, BITRE, Canberra ACT.
- {2} Bob Carnaby, Potters Asia Pacific, 2005, Poor Road Markings Contribute to Crash Rates, 2005 Australasian Road Safety Research Policing Education Conference

Connected and Automated Vehicle Trials, Austroads Webinar
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Carlson Paul J, Avelar Raul, Park Eun Sug & Kang Don, 2015. Nighttime Safety and Pavement Marking Retroreflectivity on Two-Lane Highways: Revisited with North Carolina Data

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