Submission
No 110

INQUIRY INTO USE OF E-SCOOTERS, E-BIKES AND RELATED MOBILITY OPTIONS

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Date Received: 12 August 2024

Submission to Portfolio Committee No.6 - NSW Upper House
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8 August 2024

Inquiry into use of e-scooters, e-bikes and related mobility options

Key points

- I support the use of micromobility devices on public roads and footpaths, subject to the following points
- Design and performance requirements should be applied for three types of public infrastructure:
  - A. footpaths,
  - B. bicycle paths, shared paths and roads with a speed limit no more than 50km/h
  - C. roads with a speed limit greater than 50km/h
- Devices using footpaths (Type A) must be set to a maximum speed under power of no more than 10km/h and a switchable low speed mode of no more than 5km/h. The speed mode selection must be clearly evident to the rider and enforcement personnel. The width must not exceed 740mm and unladen mass not more than 60kg (separate requirements apply to powered wheelchairs including mobility scooters).
- Devices using Type B infrastructure must have a maximum speed under power of no more than 25km/h and must not be capable of being adjusted to a higher speed setting. The width must not exceed 800mm and unladen mass not more than 60kg.
- Devices using Type C infrastructure must meet Type B requirements and also must be capable of human-powered speeds in excess of 25km/h (without power assistance. For example, it must have pedals or other means of human propulsion).
- Other safety-related requirements as set out below.
- A national technical standard be developed and used for fit-for-purpose determinations under Australian Consumer Law.
- Any powered device that is capable of powered speed in excess of 25km/h must be registered and comply with applicable Australian Design Rules in order to use public infrastructure.

Introduction

Thank you for the opportunity to make a submission to this inquiry. I am a consulting mechanical engineer with extensive experience in vehicle safety, including micromobility vehicles (e.g. e-bikes) using footpaths and other public infrastructure:

- In 2001 I conducted, for Vicroads, an analysis of the relative safety performance of bicycles and recreational scooters[1]. This included developing stability and braking tests.
  http://www.mpainesyd.com/filechute/scooter_report_dec01.PDF
- From 2008 to 2010 I led a team of experts that developed a draft national policy framework for micromobility vehicles[2]. This work was conducted for Austroads - the national association of state road authorities. A summary of key findings is provided below and an international conference paper on the technical findings is attached as an appendix.
- From 2012 to 2016 I led a team of experts that developed, for Austroads, a draft policy framework for motorised wheelchairs and other motorised mobility devices (MMD)[3]. A summary of key findings is provided below and an international conference paper on the technical findings is attached as an appendix.
- Our proposed technical requirements for MMDs were subsequently incorporated in Australian Standard Technical Specification 3695.3:2018 "Wheelchairs: Requirements for designation of powered wheelchairs and mobility scooters for public transport and/or road-related area use". Our team was a member of the Standards Australia committee that developed the technical specification.

Both Austroads projects contributed to subsequent national policy-making although it was disappointing that our key recommendations were not adopted at the time because the consumer market now has many devices that don't comply with the relatively simple safety measures. Enforcement of new safety requirements will be difficult pssibilty except for controlling the sale of new micromobility devices.

Speed amongst pedestrians

In the case of mixing with pedestrians on footpaths there is a fundamental difference between an ambulant pedestrian and a wheeled device - the perception of speed. Usually it is easy to judge an appropriate speed for the circumstances when walking (~4km/h), jogging (~8km/h) or running (~12km/h) due to the change in gait. However, a wheeled device gives very little haptic feedback on speed and so it easy easy to travel too fast for the circumstances.

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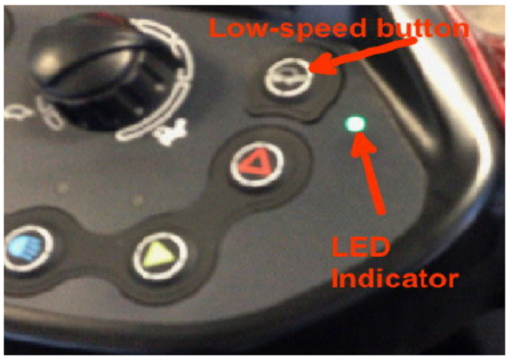
[1] Paine M (2001) ANALYSIS OF RELATIVE SAFETY PERFORMANCE OF BICYCLES AND SCOOTERS, Report prepared for Vicroads. https://www.vdrsyd.com/mp/scooter.html

[2] Paine M (2011) SAFETY REQUIREMENTS FOR SMALL MOTORISED ALTERNATIVE VEHICLES, Proceedings of the 22nd International Conference on the Enhanced Safety of Vehicles, Washington DC. https://www-nrd.nhtsa.dot.gov/departments/esv/22nd//files/22ESV-000108.pdf (see appendix)

[3] Paine M (2019) NEW SAFETY STANDARDS FOR MOTORISED MOBILITY DEVICES IN AUSTRALIA, Proceedings of the 26th International Conference on the Enhanced Safety of Vehicles, Eindhoven. http://www-esv.nhtsa.dot.gov/Proceedings/26/26ESV-000205.pdf (see appendix)

For this reason an important finding from our research is that motorised micromobility devices must have reliable, tamper-proof speed limiters so that appropriate safe maximum speeds can be applied for the infrastructure and circumstances.

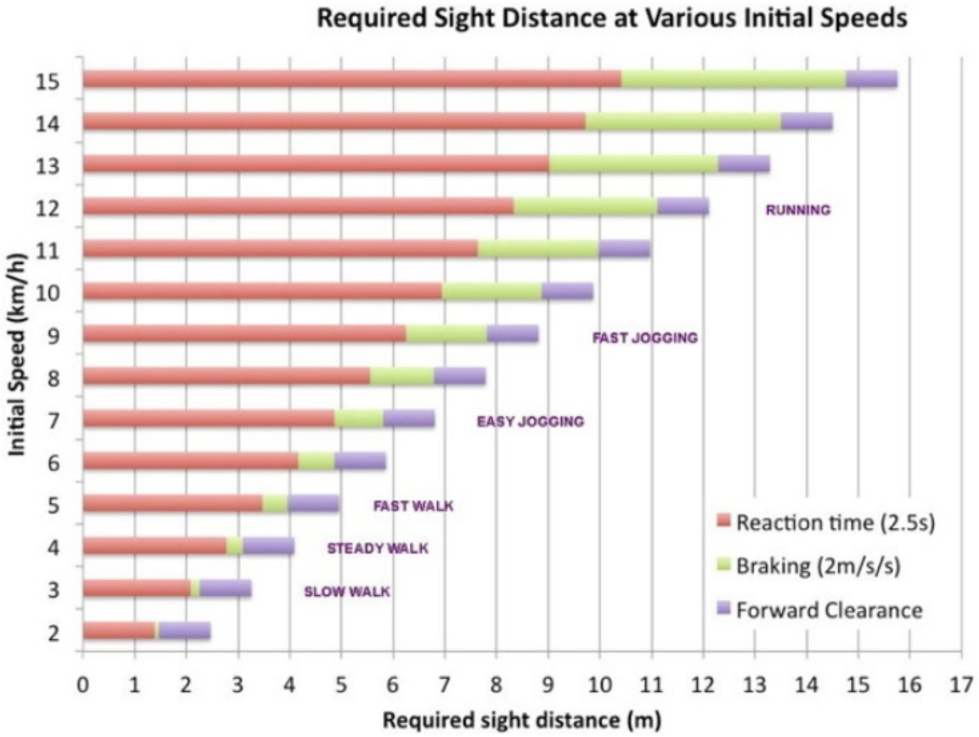
For example, ASTS 3695.3 requires *"On powered wheelchairs [including mobility scooters] with a maximum speed above 6 km/h, the powered wheelchair control system shall have an operator-controlled switch or speed mode that limits the maximum speed to 5 km/h or less. The powered wheelchair shall indicate to the operator when it is in this mode."*



Low speed switch for UK mobility scooters

The low-speed switch requirement was based on a UK requirement for mobility scooters.

The 5km/h value was based on research that I undertook to determine appropriate speeds for avoiding collisions with pedestrians in potentially congested areas such as shopping precincts and transport hubs. This built on work that I undertook in 2000 with Dr Michael Henderson on reducing the risk to children from reversing motor vehicles[4].



[4] Paine M (2003) THE DANGER TO YOUNG PEDESTRIANS FROM REVERSING MOTOR VEHICLES, Proceedings of the 18th International Conference on the Enhanced Safety of Vehicles, Nagoya. http://www-esv.nhtsa.dot.gov/Proceedings/18/18ESV-000466.pdf

On footpaths total collision avoidance is crucial because a pedestrian who is struck by a micromobility device is likely to fall heavily onto the pavement. A head impact in these circumstances could be very serious. Similarly, a pedestrian attempting to dodge an approaching micromobility device could easily trip and impact the pavement.

In areas where there is less pedestrian congestion, such as relatively quiet suburban footpaths, a maximum device speed of no more than 10km/h is necessary to avoid collisions. This is the same as the 10km/h speed limit that applies to cars in shared pedestrian zones.

Micromobility devices that cannot be ridden at very low speeds (due to stability issues) must be of a design that the rider can easily get off and walk beside the device when in congested pedestrian areas. The option to walk a micromobility device (or bicycle) through a crowded pedestrian area should be included codes of practice and training for using these devices.

In summary, *no micromobility device should be ridden in excess of 10km/h when using footpaths and they should not be capable of exceeding 5km/h (through a low-speed switch or geofencing) in designated pedestrian areas such as shopping precincts, tourist precincts and transport hubs*.

Safety requirements based on infrastructure

As set out in the 2010 report for Austroads, our team identified three fundamental types of infrastructure on which micromobility devices might be used:

A. Footpaths shared with pedestrians
B. Bicycle paths, shared paths (pedestrians and bcicycles) and some residential roads
C. Roads with speed limits greater than 50km/h

Each of these has safety-related technical limits on maximum speed, maximum width and maximum mass.

As outlined above, for footpaths we recommended a maximum speed under power of 10km/h, with the ability to select a speed no more than 5km/h for certain pedestrian areas. A maximum width of 740mm was recommended, based on Austroads Guidelines for footpath design and the need to avoid pedestrians having to dodge out of the way of a micromobility device.

For bicycle paths, shared paths and residential roads we recommended a maximum speed under power of 25km/h and a maximum width of 800mm.

The same requirements apply to devices using roads with a speed limit in excess of 50km/h except that, as with pedelecs[5], they must also be capable of human-powered speeds in excess of 25km/h (without power assistance). For example, it must have pedals or other means of human propulsion and power-assistance must not be available beyond 25km/h. One reason for this requirement is to avoiding hindering traffic flow and minimise incompatibility on Type C roads.

[5] https://en.m.wikipedia.org/wiki/Pedelec

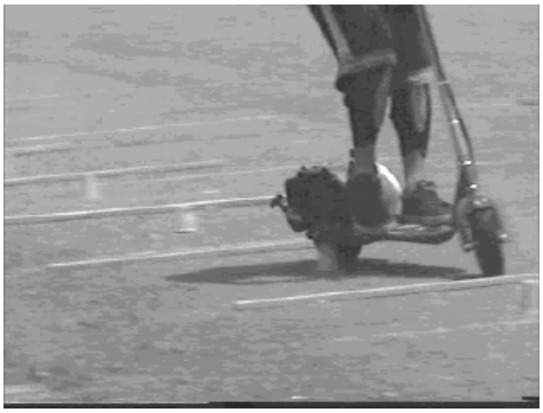
It is noted that pedelecs require the rider to pedal continuously and, as a result, many jurisdictions treat them as bicycles. Our proposal would allow powered propulsion up to 25km/h without the need for pedalling. Many e-bikes and e-scooters that are currently illegal would meet this proposed requirement, subject to other safety requirements.

This means than, *in order to use public roads and road-related infrastructure, any device capable of powered speed in excess of 25km/h must be registered and comply with applicable Australian Design Rules such as those applying to mopeds.*

It is feasible for one device to meet the requirements for all three types of infrastructure, provided that speed ranges can be selected and are clearly indicated to users and enforcement personnel.

In the case of maximum unladen mass we recommended 60kg for micromobility devices.

Other safety requirements, such as stability and braking are recommended in our Austroads report. For example there are performance tests where the device is ridden across obstacles in the path.



Performance test with obstacles across path

Furthermore, internal combustion engines should not be permitted on micromobility devices.

It is noted that in 2013 Staysafe examined the safety of "non-registered motorised vehicles"[6], including mobility scooters but this was before our Austroads project was completed.

Safety requirements for mobility scooters

Although powered wheelchairs/mobility scooters are not within the scope of the inquiry some important findings from our 2012-2016 Austroads project are relevant. Our conference paper setting out key requirements is included as an appendix.

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[6] Joint Standing Committee on Road Safety (Staysafe) (2014) REPORT ON NON-REGISTERED MOTORISED VEHICLES, report 3/55, March 2014

Recommendations for administrative arrangements

Our 2010 report included an analysis of options for vehicle and user identification. At the time we pointed out that it was desirable to register Type B and Type C devices and licence their riders (but not Type A devices such as mobility scooters). However, clearly the horse has bolted and there are now so many micromobility devices in use that conventional registration and licensing is not feasible.

Other options that were evaluated were a) that riders carry an acceptable form of identification or b) that riders have a certificate of competency (such as training provided by the supplier). It is recommended that these options be considered by the committee.

Regarding the need for certification/approval of devices, the proposal developed for mobility scooters could be extended to micromobility devices. During consultation with ACCC during the mobility scooter project it was recognised that a simple labelling system, where the manufacturer claimed conformity with published technical requirements, would be enforceable under Australian Consumer Law. Therefore there could be reasonable assurance that a product met safety requirements without the resources needed for third-party certification or government approval of each model of device. An example label from the Technical Specification is shown below.

It is recommended that technical standards for micromobility devices that use public infrastructure in Australia be developed and include labelling requirements similar to those in ASTS 3695.3. The requirements could be published by Standards Australia or as a Vehicle Standards Bulletin published by the Australian Motor Vehicle Certification Board.

White Label for footpath use - from SA TS 3695.3
(© Standards Australia)

Appendices - 2011 and 2019 papers from the International Conference on the Enhanced Safety of Vehicles (ESV)

SAFETY REQUIREMENTS FOR SMALL MOTORISED ALTERNATIVE VEHICLES

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Paper Number 11-0108

ABSTRACT

In recent times there has been an increase in the development, availability and use of small, motorised vehicles that may be alternatives to more conventional modes of personal transport such as bicycles or cars. Much of the interest in these 'alternative vehicles' (AV) is in their perceived benefits for pollution and congestion reduction.

To date there has been no uniform global approach to rules and standards governing the use of AVs. Regional requirements have mostly been applied on an ad hoc basis, differing significantly between jurisdictions. This has led to a highly prescriptive approach. This has tended to constrain innovative design, often because the vehicle concerned does not meet a regulatory definition.

In many jurisdictions there appears to be confusion amongst retailers, suppliers, consumers and enforcement agencies as to what types of AV may be legal and what rules govern their use. The differences between jurisdictions also mean that manufacturers and suppliers cannot easily design a single vehicle to market in a number of regions.

We review the types of AV that are available, or are under development, the limitations of the infrastructure on which they might be used and the safety issues arising from a mix of conventional road/path users and AVs.

INTRODUCTION

Alternative Vehicles (AVs) are small motorised wheeled vehicles that are used for personal transport but differ in construction from conventional vehicles such as cars, motorcycles and bicycles and do not comply with applicable vehicle regulation for cars or motorcycles. In Australia most types of AV cannot be registered and cannot be used on public infrastructure. Exceptions include electric wheelchairs, mobility scooters and power-assisted pedal cycles.

There are an increasing number of new types of AV that attract public attention. There is also lobbying to allow these vehicles to be used on public paths, cycleways or roads. The argument is often put forward that these vehicles will be used instead of cars and so will result in reduced pollution and less traffic congestion. Countering this are concerns about the safety of pedestrians and cyclists, if these vehicles are used on footpaths or bicycle paths, and concerns about the riders of these vehicles, if they mix with conventional cars.

A review of international practices suggests that jurisdictions are having difficulty catering for alternative vehicles. There are no international vehicle standards that can be applied in their entirety to cover all concerns about the safety and operation of alternative vehicles.

ROAD VEHICLES

In Europe there is a class of vehicles known as quadricycles that are car-like but are not required to comply with modern crashworthiness requirements. Similarly, in the USA there are regulations to allow Low Speed Vehicles on some roads.

Transport Canada and the Insurance Institute for Highway Safety have each conducted crash tests of quadricycles and have expressed strong concerns about the lack of crashworthiness and the risk to occupants in relatively low speed collisions with cars.

Figure 1. Transport Canada crash test of a car-like quadricycle vehicle (40km/h full frontal)

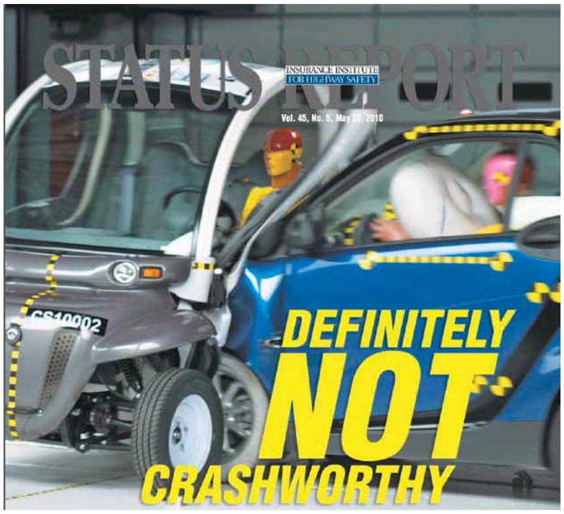

Figure 2. Cover of IIHS Status Report

In contrast there are now several models of fully electric car that have similar environmental benefits to electric quadricyles but are designed to meet car crashworthiness standards. For example the Mitsubishi i-MiEV recently achieved a 4 star rating from the Australasian New Car Assessment Program.

In the author's view any car-like vehicle should be required to meet crashworthiness regulations that apply to conventional cars. They are not considered to be alternative vehicles.

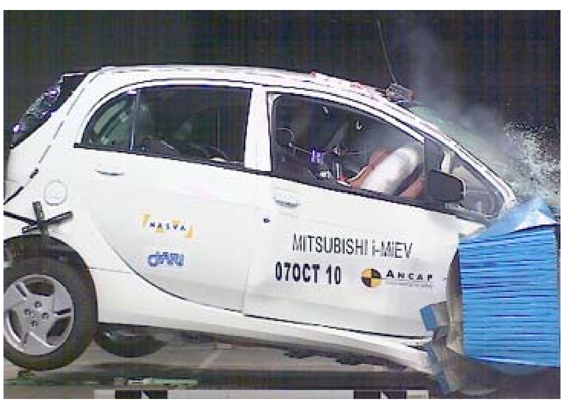

Figure 3. ANCAP crash test of Mitsubishi i-MiEV (64km/h frontal offset)

Power-assisted bicycles (PAB) are a form of AV that regularly shares the roads with cars. Like cyclists and motorcyclists, the riders of these vehicles are highly vulnerable to injury in a collision, compared with car occupants. A key difference, compared with quadricycles, is that the riders of bicycle-like vehicles feel vulnerable and usually ride accordingly.

In Australia power-assisted bicycles are limited to a motor power of no more than 200W. They must also have human (pedal) power as the primary means of propulsion. There are proposals to change from power-limiting to electronic speed-limiting for electrically powered PABs. The concept is that the electrical propulsion cuts out at speeds above 25km/h (the same as light mopeds in some European countries) but the rider can still use pedal power (or other human power) to travel at higher speeds, like a conventional bicycle.

Based on an analysis of speed and injury risk (see later), it is proposed that no AV be capable of powered travel in excess of 25km/h and that only those AVs capable of human propulsion above this speed be permitted to use roads with traffic travelling at commuting speeds (e.g posted speed limit greater than 50km/h). This is the current situation with power-assisted and unpowered bicycles in Australia.

In Australia bicycle lanes beside roads and dedicated bicycle paths are designed for a bicycle no more than 800mm in width. This width limit should apply to all AVs.

FOOTPATH VEHICLES

Vehicles that are intended to mix with pedestrians on footpaths are associated with special safety concerns. With frail (aged or very young) pedestrians any type of collision could lead to serious injury and even the need for a pedestrian to dodge out of the way of a vehicle can be hazardous. Therefore a vehicle used on footpaths must be capable of travelling and manoeuvring at very low speeds (one or two km/h) so their riders can avoid collisions with pedestrians.

It is noted that bicycles are not capable of travelling at the very low speeds needed for safely mixing with pedestrians because they need to travel at a minimum speed in order to be stable. This is one reason that most jurisdictions do not let bicycles ride in pedestrian areas - except where there are shared facilities designed for this purpose.

Footpath vehicles should also be top speed limited (4km/h for busy areas and 10km/h for other areas - see later). Limits on vehicle width are also appropriate. In Australia there are national guidelines for the design of footpaths and these are based on a standard unpowered wheelchair that is 740mm wide. This maximum width would be appropriate for any AV that uses a footpath.

AVs are being promoted as a "green" alternative to cars and as a means of commuting to work or to a bus/train station. Any relaxation of current requirements to permit AVs on footpaths should be based on stringent safety and environmental conditions. Zero tailpipe emissions and minimal engine noise are appropriate (i.e. electric powered AVs). Portability is also a consideration. A kerb mass limit of 60kg would allow the rider to manually negotiate steps and other common obstacles and for two people to lift the vehicle, where necessary. An exception is mobility scooters designed for mobility-impaired riders, where extra features are needed and a kerb mass limit of 150kg is recommended.

BICYCLE PATHS

Most major cities in Australia have strategies to encourage bicycle use, including the provision of infrastructure designed for bicycles, such as dedicated bike paths (separate from roads) and shared paths where pedestrians and bicycles travel in an orderly manner. Bike paths are usually designed for vehicles no more than 800mm in width travelling at up to 25km/h, where conditions permit. These limits should apply to AVs using bike paths.

It is important that any AVs that use bike paths do not hinder the flow of bicycle traffic. Therefore it is recommended that any powered AV be capable of maintaining a speed of 8km/h on a 5% gradient.

SAFE SPEEDS

The risk of fatal injury in the event of a collision is strongly linked to the collision speed that, in turn, is linked to vehicle travelling speeds. The fatality risk for pedestrians and cyclists reaches 5% at collision speeds of 25km/h and 10% at 30km/h (Wramborg 2005). The corresponding values for modern cars are 65km/h and 70km/h respectively. Car occupants have much less risk due to advanced restraint systems (seat belts and airbags), a strong passenger compartment and energy absorbing structures at the front.

This analysis indicates that, for vulnerable road users, collisions in excess of 25km/h should be avoided. This is the proposed maximum powered speed for any AV. Under many circumstances lower speeds are appropriate.

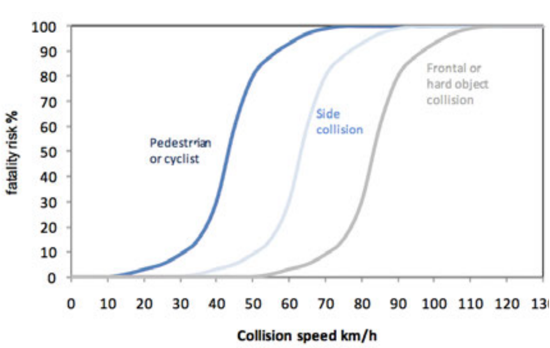

Figure 4. Risk of fatal injury (Wramborg 2005)

A design aim for pedestrian infrastructure should be to minimise the risk of any collision with a vehicle. A primary factor in collision avoidance in these cases is vehicle speed.

In a study of the pedestrian danger from reversing motor vehicles, Paine (2003) evaluated the probability of collision avoidance for a range of detection distances and car speeds. The results apply to any vehicle moving slowly in either the forward or the reverse direction. Based on 95% collision avoidance, a rule of thumb is that the vehicle speed in km/h should be no more than twice the detection distance in metres. Therefore, for a vehicle travelling at 10km/h, the detection distance (at which the driver is alerted to an object in the path of the vehicle) should be no less than five metres.

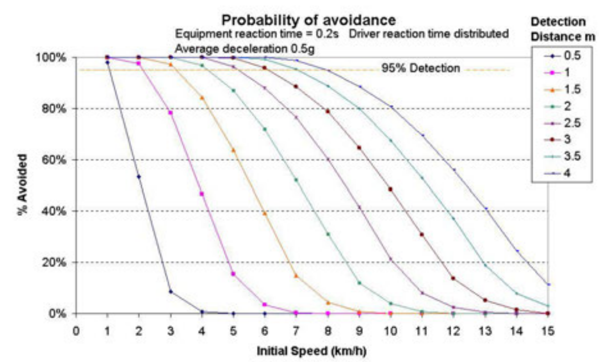

Figure 5. Low speed collision avoidance (Paine 2003)

The results of this analysis place severe limitations on the safe speeds at which alternative vehicles can share infrastructure with pedestrians. On un-crowded footpaths (typical of residential streets and shared paths) a 5m hazard detection distance is considered typical. In these circumstances a 10km/h speed limit is appropriate. On busy footpaths and footpaths with visual obstructions, such as blind corners, a hazard detection distance of 2m is considered typical and so a 4km/h limit would be appropriate.

Mobility scooters have a collision-avoidance disadvantage because the front of the vehicle is some one metre forward of the rider's eyes ("forward projection" = 1m). This reduces the distance available to stop once a hazard is detected. It is therefore important that conservative decisions are made about appropriate speeds for AVs on footpaths.

With the proposed electronic speed limiting of AVs there is scope to have speed ranges to suit the particular infrastructure. In this case a speed range indicator, clearly visible to other infrastructure users, would be appropriate.

OTHER CONSTRUCTION REQUIREMENTS

Other vehicle construction to be considered include:

- Maximum acceleration
- Braking performance
- Rider controls (throttle, braking, steering)
- Height with rider
- Tipping stability
- Manoeuvrability
- Lighting & conspicuity
- Minimum and maximum noise
- Vehicle identification

CONCLUSIONS

Since infrastructure on which AVs would be expected to operate tends to be bicycle or pedestrian-based there is good scope for achieving a global or national standard that will be compatible with existing infrastructure and will ensure that AVs can operate safely amongst other infrastructure users. It is recommended that an international working group be formed to develop a draft standard for construction and performance of AVs, taking into consideration the factors raised in this paper. It is important that infrastructure designers contribute to this standard.

The development of technical standards is only one part of an overall policy framework to deal with AVs. More daunting are the tasks of determining if and how vehicle registration and rider licencing should apply to AVs and which types of AV should be allowed to use public infrastructure. There are also issues of accident insurance and regulation amendments to consider.

Vehicles complying with a global technical standard should not automatically be granted access to public infrastructure. If, after a range of policy issues have been considered, it is decided that particular types of AV will be allowed to use public infrastructure in a certain region then global technical standards will assist in the implementation of this policy.

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DISCLAIMER

This paper represents the author's views and does not represent the views or policy of any organisation. It is intended as a discussion paper and is based on research conducted for several projects over the past decade. I thank my colleagues in those projects.

NEW SAFETY STANDARDS FOR MOTORISED MOBILTY DEVICES IN AUSTRALIA

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Paper Number 19-0205

ABSTRACT

A motorised mobility device (MMD) is primarily intended as assistive technology for people with limited mobility. MMDs include powered wheelchairs and mobility scooters. In recent years concerns have been raised about the number of fatal and serious incidents with these devices in Australia. These incidents are not reliably recorded in crash reporting systems but special studies indicated that several hundred Australians are hospitalised each year due to incidents involving MMDs. A review using the safe-systems approach resulted in recommended minimum safety requirements for the design of MMDs intended to be used on footpaths/sidewalks and other public infrastructure. In 2018 Standards Australia published a new Technical Specification settings out these requirements. This paper provides background on the development of these requirements.

INTRODUCTION

In 2012 Austroads, the peak organisation of Australian and New Zealand road transport and traffic agencies, began a review of the safety of MMDs. This followed on from a review by Vicroads in 2009 and a project initiated by the Australian Competition and Consumer Commission (ACCC), as well as concerns expressed by road transport agencies about the safety of MMDs.

RESEARCH FINDINGS

A study commissioned by the ACCC estimated that between 2006 and 2008 the average number of hospitalisations involving MMD users was at least 350 per year. It was found that injury-causing incidents with MMDs were poorly reported by road crash data systems (i.e. police-reported data) and hospital recording systems. Recording of fatalities was more reliable due to the coronial process and between 2000 and 2010 there were 62 fatalities recorded in Australia (Gibson 2011, VISU 2006), although some were medically-related.

In 2008 it was estimated that about 80,000 MMDs were in use across Australia (Griffiths 2010). There is considerable uncertainty about current numbers but it is thought to exceed 200,000 because the number in use appears to be doubling every five years, based on trends with registration of MMDs in Queensland - the only State that requires MMDs to be registered for footpath use.

It was found that the serious crash risk was much higher than conventional vehicles in terms of kilometres travelled. There are numerous reasons for this relatively high rate, including frailty of some users and low annual kilometres travelled but the findings support the need to minimise the consequences of human error or misjudgement through the clever design of MMDs.

In accordance with the safe-systems principles it was concluded that MMD construction requirements were appropriate and that these should be based closely on an existing Australian Standard AS/NZS 3695.2:2013 "Requirements and test methods for electrically powered wheelchairs (including mobility scooters): 2013". However it was recognised that some aspects of that standard were too onerous for the intended application (leading to unnecessary compliance costs) and that some extra requirements were needed to address safety and access issues not adequately covered by the standard.

Overseas standards were also found to be incomplete for the purpose of safe use of MMDs on footpaths but they contained some useful and innovative ideas that were incorporated into the proposed technical requirements.

DEVELOPMENT OF A TECHNICAL SPECIFICATION

After consultation with Standards Australia and stakeholders it was decided that a Standards Australia Technical Specification (SATS) was an appropriate method for publishing the desired technical requirements.

A key reason for this decision was that demonstrating compliance with a Technical Specification is much less onerous than having a product certified to an Australian Standard. During the Austroads review it was recognised that a simple labelling system, where the manufacturer claimed conformity with published technical requirements, would be enforceable under Australian Consumer Law. Therefore there could be reasonable assurance that a product met safety requirements without the resources needed for third-party certification.

An existing Standards Australia committee, highly experienced in assistive technology requirements, took on the task of drafting the SATS.

The result was SATS 3695.3:2018 "Wheelchairs: Requirements for designation of powered wheelchairs and mobility scooters for public transport and/or road-related area use". Standards Australia published the SATS in mid-2018.

CONTENTS OF THE TECHNICAL SPECIFICATION

The SATS refers to many of the requirements set out in AS/NZS 3695.2:2013. In brief, the TS requires MMDs to demonstrate dynamic and static stability on slopes, limits the dimensions and mass of devices, introduces a slow speed switch for devices that can exceed 6km/h, and requires that devices can negotiate uneven surfaces and obstacles.

Stability on slopes

AS/NZS 3695.2:2013 recognises three classes of MMD (paraphrased):

- Class A are primarily intended for indoor use and are not necessarily capable of negotiating outdoor obstacles
- Class B are relatively compact and are intended for indoor and outdoor use
- Class C are large and are primarily intended for outdoor use

Class B requirements were found to be the most appropriate to safety requirements for MMDs used on footpaths. This required the device to be tested on a 6 degree slope as a minimum for dynamic stability (e.g. turning on a slope) and 9 degrees for static stability (e.g. remaining stationary on a slope and for parking brake performance).

For devices intended for use on public transport a 7.1 degree slope was found to be appropriate for dynamic stability tests, based on Australian Disability Standards For Accessible Public Transport (DSAPT) (e.g. boarding ramps).

Speed

Each Australian state and territory sets its own road rules. These are based on the ARR, which are intended as a template for those road rules. For road rule purposes MMDs and their users are treated as pedestrians, provided that the maximum speed on level ground does not exceed 10km/h. This requirement has applied for more than 20 years.

A review of the speed issue included an analysis of sight distances needed to avoid a collision. This was based on established road design practices that took into account reaction times and braking distances. In the case of low speed situations it was also necessary to account for forward projection - the distance from the person's eyes to the front of the device (Figure 1). Because MMDs are often used amongst frail pedestrians the calculations were based on total collision avoidance.

Based on this analysis it was found that the speed of travel in km/h should not exceed the available sight distance in metres (Figure 2). For example, a sight distance of 5m, typical of uncrowded footpaths, requires a travel speed of no more than 5km/h. It was found that 10km/h (i.e. 10m sight distance) was an appropriate maximum speed for MMDs using footpaths and other public infrastructure but they should travel at much slower speeds in crowded areas.

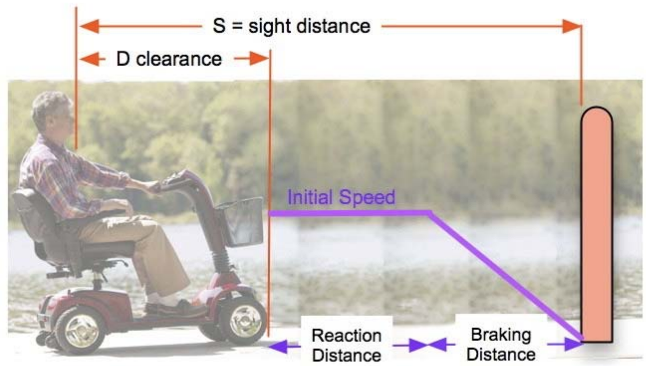

Figure 1. Stopping scenario

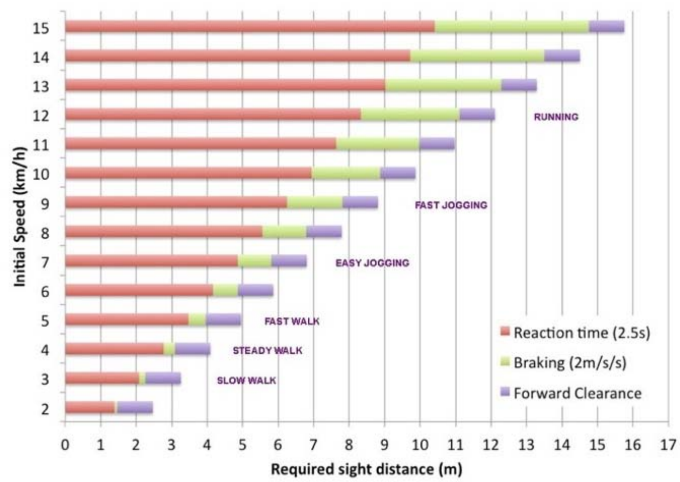

Figure 2. Relationship between speed and sight distance

It was also recognised that, at these relatively low speeds, any motorised wheeled device gives a poor perception of speed compared with ambulation, where gait is a reliable indicator of speed (labels on Figure 2). This has been addressed by requiring a low speed switch that limits the MMD to 5km/h. The switch is not required if the MMD has a maximum speed not more than 6km/h. Most MMDs in the United Kingdom that are capable of exceeding 4mph (~6kmh) are required to have a low speed switch (Figure 3).

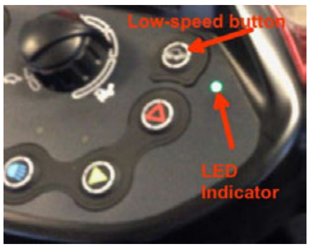

Figure3. Low speed switch

Unladen mass and dimensions

The ARR require MMDs to have an unladen mass no more than 110kg. It is apparent that many MMDs in use in Australia exceed this limit and several Australian states have increased this to 150kg in their regulations. The review looked at this issue.

It is desirable that the laden mass (MMD, user and luggage) does not exceed 300kg based on infrastructure and equipment capacities (e.g. ramps and lifts). Based on anthropometric data and a survey of devices in use an unladen mass limit of 170kg was considered to be appropriate for mobility scooters in the SATS. In recognition of the issues associated with medical needs, powered wheelchairs have no limit on unladen mass but are recommended to not exceed 300kg laden mass.

Maximum width and length were based mainly on the design parameters of infrastructure and public passenger vehicles (Standards Australia 2010, Austroads 2009). For general infrastructure MMDs must not exceed 850mm in width and 1500mm in length.

For MMDs intended to be conveyed by public transport the maximum width is 740mm and length depends on swept path and manoeuvrability tests specified in the SATS. There are several other requirements that apply to these "blue label" MMDs (Figure 5) to ensure improved compatibility with mass-transit vehicles. These requirements took into account the accessibility and allocated space requirements of the DSAPT that apply to public passenger vehicles in Australia.

Obstacles and hazards

AS/NZS 3695.2:2013 includes tests for safely negotiating obstacles and others hazards. Class B MMDs are tested with 50mm high obstacles and 30mm ground unevenness.

In addition the SATS has a test for traversing a pavement gap 75mm wide, such as those found at railway level crossings. There is also a test for lateral stability if one wheel of the MMD drops down a step transition 50mm high that is parallel to the pathway (some incidents involve an MMD suddenly swinging into an adjacent traffic lane when this occurs).

Labelling conforming MMDs

The SATS describes the content of user information to be provided with new MMDs and the specifications of a label to be affixed to the device. The label includes the words "This product conforms with SA TS 3695.3" (Figures 4 & 5). This wording is associated with Australian Consumer Law that, in effect, requires products sold in Australia to be fit-for-purpose.

Figure 4. White Label for footpath use
(© Standards Australia)

Figure 5. Blue Label for compatibility with suitable public passenger vehicles (© Standards Australia)

Now that the SATS is published MMD manufacturers are able to test their products and claim that they conform with the requirements of the SATS. In this way they can ensure the product is suitable for use on footpaths and other public infrastructure and so is fit-for-purpose.

Similarly, purchasers of MMDs can choose a product that meets their needs by checking for the presence of and the colour of the label.

CONCLUSIONS

Incidents involving MMDs are not reliably reported in Australia and this seems to also be the case elsewhere. Specially-commissioned injury research in Australia found a high serious injury rate (e.g. per kilometre travelled) compared with other motorised transport. While there are several reasons for this there is a strong case for a safe-systems approach where the MMD design and construction minimise the consequences of human error or misjudgement.

The number of MMDs in use in Australia is likely to be doubling very five years as the population ages and people seek to retain their mobility.

Until recently very little attention has been paid to the safe design of MMDs and the market is effectively unregulated. While clearly the assistive technology industry is experienced and provides suitable products (ATSA 2011) there is, in effect, nothing to prevent inexperienced, unqualified people from selling inferior products in Australia.

The development and publication of SATS 3695.3 is a major step in efforts to address this safety issue.

User behaviour is another matter...

Figure 6. Only in Australia!

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ACKNOWLEDGEMENTS

This work was undertaken by Austroads to support the preparation of appropriate safety requirements for MMDs in the form of the SATS. Standards Australia Committee ME067 drafted the SATS. The authors participated in that task.

DISCLAIMER

This paper represents the authors' views and does not represent the views or policy of any organisation.