

The European Union Road Federation (ERF), the Brussels Programme Centre of the International Road Federation (IRF)



Brussels Programme Centre

DISCUSSION PAPER

February 2009



Road Infrastructure Safety of Powered Two-Wheelers

Table of Contents

I) Introduction	Page 3	
II) PTWs in the real world	Page 3	
III) The dynamics of PTW collisions	Page 4	
IV) Safer road engineering	Page 5	
V) A challenge for all	Page 7	
VI) Conclusions	Page 10	
VII) About the authors	Page 11	

This study is also available at www.irfnet.eu/en/position-papers

I) Introduction

A growing trend the European continent has experienced is the constant increase in the diffusion of Powered Two-Wheelers (PTWs) as an alternative or complementary mean of undertaking personal transport. Scooters, mopeds and motorbikes are now more than a common sight on all categories of roads, their popularity having considerably increased, especially within the urban environment, due to a number of factors.

The popularity of these vehicles means that infrastructure needs to be built, maintained and upgraded taking into consideration the different needs of these types of users. The very often terrible consequences of accidents involving PTWs are a constant reminder that, much too often, infrastructure is not designed to ensure the maximum possible levels of safety for motorcycles and mopeds.

There is hence a need to propose innovative solutions and to implement the already existing ones so that PTWs enjoy increasing levels of safety on European infrastructure. Europe is starting to take note of the problem, with European Commission Vice-President Antonio Tajani stating that “the problem of motorcycles must be tackled head on, as it represents 17% of deaths on the road “¹.

With PTWs users suffering from high levels of risk, it is necessary for all the actors involved to start a reflection on the problem and define shared solutions which will help reduce the number of powered two-wheeler fatalities on European roads and set our continent back on track towards reaching the ambitious goal of reducing the number of road-related fatalities to 25,000².

II) PTWs in the real world

In 2007 more than 2.4 million PTWs were registered in the EU 27, a number which is increasing every year after having reached a peak in 1999 and suffered a slump in the following years³. There are currently an estimated 33 million PTWs in circulation in the EU 27 countries, from small 50cc mopeds to powerful motorcycles. These represent about 14% of the entire European private vehicle fleet (cars and PTWs only), but they account for around 17% of the fatalities.

This disproportion between the participation to traffic and the level of fatal accidents is a direct consequence of the vulnerability of PTW users. Aside from the helmet and protective clothing, in fact, riders do not benefit from a hard shell to protect them



¹ II European Road Safety Day, Paris 13 October 2008

² “European transport policy for 2010: time to decide”, European Commission, 2001

³ ERF, “European Road Statistics 2008”; ACEM, “Yearbook 2008”

during a collision and, furthermore, they are not physically bound to their vehicle, resulting in accidents where they are propelled at high velocity against fixed or moving objects. This means that, in case of an accident, motorcyclists can suffer severe and frequently fatal injuries, even at relatively low speeds.

According to a study financed by the European Commission⁴, the most frequent collision is between a PTW and a passenger car, accounting for 60% of the cases examined. Following this type of accident is the collision between the PTW and the infrastructure, with 9% of occurrences. In this latter case it is important to analyse the factors which caused the loss of control of the PTW, those which contributed to the rider not being able to recover the situation and ultimately those which influenced the severity of the resulting crash.

III) The dynamics of PTW collisions

Powered two-wheelers are involved in accidents with infrastructure which are of two distinct kinds and which need to be evaluated separately to determine possible remedial measures for each. Broadly speaking we can either have a case where the PTW impacts the barrier or roadside object whilst the rider is still operating the vehicle or the situation where rider and vehicle have become separated beforehand and are both sliding along the surface towards the obstacle.

Some studies point out to a prevalence of impacts with road restraint systems occurring whilst rider and PTW are still together⁵, in which case the rider is projected forward by its own momentum over and above the barrier. These types of accidents have notoriously difficult consequences to predict, as the severity of the injuries occurring to the rider depends almost exclusively on the design of the road and on the roadside furniture present on the spot.

“Infrastructure should be forgiving the rider if he makes a mistake”

A rider might, in fact, be cushioned by a soft landing over grass or he might be severely injured by impacting with a post/fence or any other hard object present nearby. The relative impossibility to anticipate the consequences to the rider of this type of accidents or to mitigate its consequences

lead us to the next broad typology of PTW and infrastructure collisions: the one where the rider and the vehicle have become separated and, whilst sliding, impact the roadside furniture.

This type of accident has particularly severe consequences when the rider, having become dislodged from the PTW, impacts a road restraint system (when present) which has not been particularly designed nor tested to this end.

Improvements ought hence to be concentrated on addressing the underlying causes which generated the loss of control of the PTW by the rider and also on mitigating as

⁴ Motorcycle Accident In-Depth Study (MAIDS), www.maids-study.eu

⁵ “Einsatzkriterien für Schutzeinrichtungen mit geringerem Verletzungsrisiko für Motorradfahrer”, Bundesanstalt für Straßenwesen (BAST) 2004

much as possible the consequences of accidents. Infrastructure should be “forgiving” the rider if he makes a mistake, allowing for sufficient recovery time & space and eventually being able to cope with a possible accident.

IV) Safer road engineering

Preventing loss of control of a PTW and mitigating the consequences of the possible accident are two areas where infrastructure has a key role to play. Through better roads it is possible to avoid altogether accidents that would otherwise cause serious injuries on PTW riders.

Prevention

Losing control of a PTW can be due to a number of different causes, many of which dig their roots in the infrastructure pillar. Road aspects such as **manholes**, for instance, need to be designed, installed and maintained bearing into consideration the fact that the vehicles going over them can also have only 2 wheels and hence a reduced grip on the surface. In a similar way, the prevention of **potholes** through regular maintenance work is also essential for PTW riders, as the road surface needs to be in excellent condition to guarantee a maximum level of security. Furthermore certain aggregates and dust in excess can lead to a **road surface becoming slippery** and have disastrous consequences for the PTW rider. Road sweepers should be employed to regularly clean the road surface. In general lack of **maintenance** is an unacceptable threat to all road users, often turning the infrastructure in a deadly trap for all type of users.



Similarly road infrastructure operators or road authorities need to ensure a good level and quality in the **road markings**, which become of considerable importance when dealing with PTW. Road Horizontal Markings, in fact, contribute to delineating the road for the user, giving him an image of the infrastructure in the metres ahead of him. Markings which are in pristine condition and which offer a good degree of reflectivity in night conditions help the rider “read” the road and plan his speed and attitude beforehand. Road markings need also to have good anti-skid properties, to avoid PTWs losing grip and sliding, especially in wet conditions. **Regular audits** with on-board apparatus should be done by the infrastructure operator/road administration in order to ensure that the anti-skid properties are high enough and always above the minimum standard.

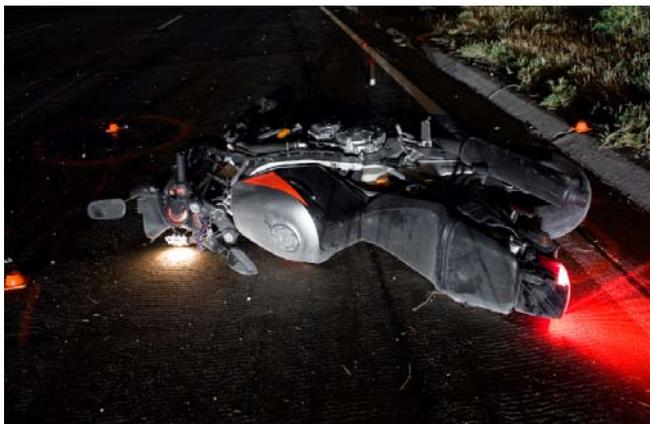
The use of **speed calming measures**, such as speed bumps, needs also to be taken into consideration when designing an infrastructure which needs to guarantee the safety of all its users. Despite some criticism, speed calming measures have proven an effective deterrent against excess speed, which is one of the contributing factors to accident causation and one of the main factors in accident severity. Careful engineering however needs to ensure that these modifications of the roadbed are not presenting a hazard to users operating vehicles with less than four wheels. **Variable message signs** can also act as a speed calming measure in that they can warn the

PTW rider that an upcoming section of the infrastructure (a curve or a series of curves) is of hazardous nature for particular categories of users, recommending him to adapt his speed accordingly.

Infrastructure can also pose a threat to PTW users because it makes it harder for other road users to spot them. The problem of **roadside clutter** means that too many signs can be obscuring the view of the motorist. In such a case the PTW user can be hidden from view by large or numerous road signs, leading to a high risk of impact with another vehicle user. A good balance between the necessity to communicate to the rider through vertical signs and avoiding a visual “blind spot” for other users is to be sought.

Mitigation

Once the PTW user has lost control of his vehicle the accident can have consequences which vary very much depending on what type (if any) of **road restraint system** is installed on that particular road section. As mentioned beforehand, in fact, some of the most serious PTW accidents happen when the rider, sliding on the roadbed, passes under the road restraint system, simultaneously impacting with one of its supporting posts.



Although additional research still needs to be conducted in the impact behaviour and injury patterns arising from the sliding PTW rider, it is noteworthy to mention that industry solutions are already present from manufacturers which prevent the specific occurrence of the rider sliding

partially under a system without changing the overall properties of the barrier. These motorcyclist-friendly road restraint systems run closer to the ground (often with a double band) and are **designed and tested to minimise the risk to the sliding PTW rider**, preventing him from going under the barrier and impacting its support posts, whilst at the same time cushioning his slide to minimise the risk of sustaining severe or fatal injuries.

Additionally the road infrastructure needs to be **designed taking into consideration all the possible accident scenarios**, maximising its safety for all types of users. This might entail more distance between the roadside and any object (post / sign) to leave space for users to attempt to regain control of their vehicle or to have them impact any object at a lower speed. Roads and roadsides need to be friendly environments which allow the normal operation of infrastructure yet become “forgiving” once an individual makes a mistake while operating a vehicle.

Prevention



Manholes
Road Design (self explaining roads)
Maintenance
Road Horizontal Markings
Speed Calming Measures
Roadside Clutter
Regular Audits
Sweeping Excess Material
Better Signalisation

Mitigation



Road Restraint Systems (RRS)
Road Design (forgiving roads)

V) A challenge for all

It is of paramount importance that actions be undertaken to improve the safety of PTW users on road infrastructure, an effort which will require the involvement at all levels of society of users, federations, local and national legislators, the European institutions, manufacturers and all those other stakeholders wishing to lend their hand to improve on the current situation. A number of different measures can be taken, almost immediately, with very little cost, if any, but which will yield enormous improvements in the safety of PTW users.

Training & Awareness

Powered two-wheeler drivers need to be constantly aware of the road they have ahead of them, scanning it for potential threats in continuation. A rider needs to be conscious of his position on the road and that of other road users, he needs to ensure that he can be seen easily by other users, whilst at the same time checking the road itself to spot any potential hazard. This attitude when using a PTW, which becomes stronger with time, needs to be instilled already from the beginning to new users, so that they become immediately aware of how they can potentially spot dangerous situations and what they can do to avoid becoming involved in a road traffic accident.



FEMA, the Federation of European Motorcyclists' Associations, undertook a study in 1997⁶, co-financed by the European Commission, which emphasised that initial rider training in Europe does not meet riders' needs. FEMA and its partners in the project, ACEM and FIM, state that improved pre-licence training would reduce the number of fatalities and injuries to PTW users, calling for more resources to be devoted to the formation of powered two-wheeler riders.

⁶ Initial Rider Training in Europe – The views and the needs of the riders, FEMA 1997, www.initialridertraining.eu



Similarly ACEM, the Motorcycle Industry in Europe, launched a pan-European safety campaign in 2008 to raise the riders' awareness about the potential risks originating in the road infrastructure itself⁷.

Other road users also need to receive specific training to ensure they are aware of the different characteristics of PTWs. In particular, there is a need to train drivers to better spot PTW, as a considerable number of accidents between vehicle and PTW are due to the former's driver lack of perception of the latter.

Improve Infrastructure

Road infrastructure offers one of the best ways to reduce accidents and injury for powered two-wheelers, already from the early stages of its design. Planners need to ensure, in fact, that when the design of the road is finalised, this encompasses all the latest safety measures for all the types of users, be it heavy good vehicles, passenger cars or PTWs. Furthermore, the infrastructure also needs to be designed so that it is self-explaining, as studies have demonstrated the increased risk of accident on road sections presenting unexpected features or layout⁸.

It is also important that the road infrastructure is in a good overall condition, that there are no potholes present, that manholes are level with the surrounding roadbed, that horizontal road markings are visible and with the appropriate anti-skid, that there is no over-abundance of vertical signs which might hide the PTW rider from other vehicle users and that the appropriate road speed calming measures be adequate to curb speed safely for all types of users. This way, by ensuring some simple maintenance to our infrastructure, we are already tipping the scales in favour of users and promoting overall safety. A good infrastructure policy is one of the essential ingredients to improve PTW policy, as outlined by the International Transport Forum⁹.

When accidents do occur, however, it is then necessary to provide roads with the latest road restraint systems studied purposefully to protect PTW users and ensure that any other roadside object be either protected or placed sufficiently distant from the roadside to avoid posing any threat.

New European Norms

Much has been done throughout the years to promote road safety and to ensure that roadside furniture meet very stringent requirements, but most actions have been concentrated towards passenger vehicles, heavy goods vehicles and pedestrian protection. The high-frequency of fatal or near fatal accidents for powered two-wheelers has brought forward a change in the situation, whereby more attention is devoted to this particular category of users.

⁷ Lucky 13 – ACEM 2008, www.acem.eu/cartoon

⁸ RANKERS – Ranking for European Road Safety, ERF – IRF BPC 2008, www.rankers-project-com

⁹ Workshop on Motorcycle Safety – International Transport Forum, June 2008

In particular the Committee of European Normalization (CEN) has mandated the drafting of a new part to the European Standard for road restraint systems¹⁰, meaning that in the near future PTW users will be benefitting from roadside barriers studies, designed and tested with their specific safety in mind.

Some European countries have already created a national standard for motorcyclist protection, with several others in the process of doing so. It is of utmost importance that all parties contribute towards the drafting of a common and harmonised European Norm (hEN) which will have a single set of criteria valid from Lisbon to Bucharest.

It is also of paramount importance that European Standards already in existence¹¹ be implemented effectively in all Member States to ensure the maximum safety of the infrastructure for PTW users. Increased safety levels can already be a reality today for all PTW users if national governments decide to take the ambitious step of ensuring their infrastructure is planned, built and maintained taking into consideration the needs of all users.

Raise Awareness

Campaigns need to be initiated at all levels to foster the idea of a safer infrastructure for PTW users, ensuring that all road infrastructure users, but in particular the most vulnerable, are provided with a road which is able to guarantee a maximum level of safety.

National governments, associations and federations, manufacturers and the European institutions need to join efforts to promote the idea of safe PTW use and to conduct campaigns aimed at better training current and future PTW riders. All other drivers also need to receive additional training and be the target of awareness campaigns aimed at instilling a better understanding on how to better spot motorcyclists on the road. Furthermore, there needs to be a drive aimed at pushing governments to install roadside protection devices specifically designed to protect PTW riders where there is a perceived risk of accidents involving this type of users as well as ensuring that maintenance be never overlooked.

A particular role has to be played by European associations and federations, which need to liaise with fellow transport stakeholders and, especially, the European institutions to guarantee that the appropriate measures be taken at EU level to protect PTW users from fatal and serious accidents.

¹⁰ EN 1317-8, Standard under Development, CEN

¹¹ EN 12767, Passive safety of support structures for road equipment - Requirements, classification and test methods, CEN

VI) Conclusions

This Discussion Paper has evidenced how powered two-wheelers suffer from increased levels of risk on European road infrastructure, but that this same level can be considerably reduced by applying simple and cost-effective infrastructure measures which will yield immediate beneficial effects. The ERF – IRF BPC believes it is the role of all stakeholders to promote a vision of roads which are inherently safe for PTW riders, knowing well that regardless of any road safety initiative, motorcycling can never be made completely risk-free.

In particular the ERF – IRF BPC calls for:

- Increased levels of maintenance of European road infrastructure to ensure that accidents are not caused by road defects which could have easily and cheaply been fixed;
- Consider the safety aspects of powered two-wheelers already at a road design stage;
- New European legislation aimed at the specific protection of vulnerable road users and particularly PTWs;
- Standards need to be revised and developed to reflect the needs of motorcyclists, encouraging PTW-friendly design, construction and maintenance;
- A new statistical tool aimed specifically at gathering information on PTW accidents to ascertain the different factors which play a role in real-life conditions;
- Specific road safety audits and inspections which take into consideration the point of view of the powered two-wheeler user and assess the infrastructure's level of safety, as foreseen in the recent Directive on Road Infrastructure Safety Management (2008/96/EC);
- The promotion of PTW-friendly infrastructure guidelines by national governments, as well as actions aimed at eradicating "PTW black spots";
- More campaigns at all levels to explain the role of the infrastructure, of the rider and of the PTW and their combined relationship;
- The establishment of a European Roads Agency dealing with all matters related with road transport and especially with safety issues, a long overdue action of the European Commission, which already boosts Agencies dealing with Maritime and Aviation safety and specific ones focussing on rail transport and the TEN-T.

Through simple yet effective actions we can still hope to meet the target of reducing the number of fatalities on European roads to 25,000. Realistically this will not be achievable by 2010, as was originally hoped, but by applying the measures suggested in this Discussion Paper we will ensure that the final date will not be so distant in the future.

VII) About the authors

The European Union Road Federation (ERF) – International Road Federation (IRF), Brussels Programme Centre

The European Union Road Federation (ERF), the Brussels Programme Centre of the International Road Federation (IRF) is a non-profit association which coordinates the views of the European road sector and acts as a platform for dialogue, information and research on mobility issues.

The ERF is part of the IRF, which was established in 1948 and has over 500 members in 6 continents. The IRF seeks to promote the benefits of valid road transport infrastructure at all levels of society.

The ERF – IRF BPC is signatory to the European Road Safety Charter and undertakes a series of initiatives with the scope of helping reduce the number of fatalities on European roads.



More information available at www.irfnet.eu

The ERF – IRF BPC wishes to express special gratitude for the important contribution to this paper to ACEM, the Motorcycle Industry in Europe and FEMA, the Federation of European Motorcyclists' Associations.



www.acem.eu



www.fema.ridersrights.org

Selected Bibliography

- Norway Public Roads Administration, “Safety, Design and Operation of Roads and Traffic Systems”, April 2004;
- IHIE, “Guidelines for motorcycling. Improving safety through engineering and integration”, April 2005;
- Gibson T. and Benetatos E., “Motorcycles and (pre-)crash Barriers”, New South Wales Motorcycle Council, 2000;
- Bouwdienst Rijkswaterstaat, “Verkeersveiligheid motorrijders; onderzoek naar oplossingen ter verbetering van de verkeersveiligheid voor motorrijders”, 2003;
- European Commission – Directorate General for Energy and Transportation, “European transport policy for 2010: Time to decide” September 2001;
- FEMA, “Final report of the Motorcyclists & (pre-)Crash Barriers Project. A project to develop recommendations to Road Traffic Authorities for reducing injuries to motorcyclists in collision with (pre-) crash barriers”, February 2000;
- Braily, “Etude des accidents des motocyclistes avec choc contre glissières de sécurité”, 1998;
- ACEM, “MAIDS - Motorcycle Accident In-Depth Study”;
- ACEM, “Guidelines for PTW-safer road design in Europe”, 2006;
- Department of Transportation (UK), “The government’s motorcycling strategy”, February 2005;
- ifz (Institut für Zweiradsicherheit e.V.), „Motorradfreundlicher Straßenbau. Motorradfreundlicher Anforderungen an Planung, Bau und Betrieb von Straßen“, 2003;
- V. Babkov and O. Andreev, “Road Designing”, 1987;
- V.Cossalter, “Motorcycle Dynamics”, 2002;
- European Commission – Directorate General for Energy and Transportation, “Green Paper on the impact of transportation on the environment - a community strategy for ‘sustainable mobility’”, COM (92) 46, February 1992;
- BAST (Bundesanstalt für Straßenwesen), “Einsatzkriterien für Schutzeinrichtungen mit geringerem Verletzungsrisiko für Motorradfahrer“, 2004;
- ERF – IRF BPC, “European Road Statistics“, 2008;
- ACEM, “Yearbook“, 2008;
- ACEM, “Lucky 13“ (www.acem.eu/cartoon), 2008;
- ERF – IRF BPC, “RANKERS – Ranking for European Road Safety” (www.rankers-project.com), 2008;
- ERF – IRF BPC, “RISER – Roadside Infrastructure for Safer Roads” (www.riser-project.com), 2005;
- ERF – IRF BPC, “Guidelines to Black Spot Management”, 2003;
- International Transport Forum, “Workshop on Motorcycle Safety”, Lillehammer June 2008.