

Motorcycle Action Group



Vehicle Restraint Systems

Safety Fences

Crash Barriers

Motorcyclists

Version 1:4

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Vehicle Restraint Systems – Safety Fences – Crash Barriers - Motorcyclists

Introduction to the Systems

- Vehicle Restraint Systems (VRS) or Safety Fences appear on the road network in several forms and are most prevalent but not confined to motorways, dual-carriageways, junctions and approaches to roundabouts.
- The main purpose of Vehicle Restraint Systems is to restrain or redirect errant vehicles from crossing central reservations into the path of other vehicles or from leaving the highway following accidents or collisions. The purpose of which is to prevent harm to vehicle occupants or other road users.
- The most common form of Vehicle Restraint Systems consists of permanent steel posts supporting steel beams (steel beam barriers), commonly identified as “ARMCO” barriers and their derivatives. Another type consists of fabricated wire cables, commonly known as wire rope barriers.
- Other forms of permanent retention systems can be identified as continuous smooth surface Safety Barriers, the most common form is constructed of concrete.
- The Highways Agency Interim Advice Note 60/50¹ states that where ADDT (Average Annual Daily Traffic) exceeds 25,000 vehicles per day, there are significant benefits in using rigid concrete rather than deformable steel barriers on busy motorways and dual carriageways. These include improved health and safety, reduced repair and maintenance requirements and greater Whole Life Cost benefits.
- Although concrete can be up to 30% more expensive to install, the average scheme costs of installing concrete barrier are assessed as being just 0.2% greater than steel, although this may be greater where changes to the central reserve drainage are required.
- However, even with this consideration the additional costs for concrete will be offset by the reduction in maintenance and associated traffic management costs². Further cost savings will result from improving safety and reducing the likelihood of crossover accidents.

A Rider's View

- Because of the nature of their construction, Vehicle Restraint Systems are viewed by motorcyclists as an aggressive means of retention.
- Due to the open nature of the design, the wire rope barrier system is viewed by motorcyclists as the most aggressive form of Vehicle Restraint Systems causing the most injuries to riders. This is due to the exposed upright permanent steel posts and wire cables.

¹ <http://www.archive2.official-documents.co.uk/document/deps/ha/jans/index.htm>

² On the M25 no replacement or maintenance of the concrete barriers in the central reserve has been necessary in two years.

- This view is supported by computer simulations³ and tests⁴ which clearly indicate that injuries will be severe if a rider hits the cables or the exposed supporting posts of Vehicle Restraint Systems.
- A common perception of motorcyclists is that when impacted by motorcyclists wire rope barriers cause a “cheese wire”⁵ or “bacon slicer” effect when the body strikes the wire cables. In our opinion, the “cheese wire” effect is only a part of the problem. This is due to the fact that striking tensioned wire ropes or the solid steel beam of Vehicle Restraint Systems will both inevitably cause some form of injury. These injuries could occur if the rider slides along the road before impact, strikes a Vehicle Restraint System in an “upright” position when mounted on the motorcycle, or if the rider is thrown onto the top of the Vehicle Restraint System.
- MAG UK notes with some concern that the upright posts as fitted to some types of solid beam barriers systems in the UK protrude approximately 20mm or more over the top of the horizontal beam. An example of this can be seen on sections of the A46 Warwick By Pass. This section of the A 46 is a dual-carriage way and utilizes wire rope barriers and solid beam barriers as the central divide. A more extreme example is present in new sections of beam barriers fitted on parts of the A1.

It is the position of MAG UK that the main cause of injury to riders are the exposed upright posts of all Vehicle Restraint Systems⁶, which are more prevalent and more exposed in wire rope systems.

Motorcyclists Only

- Vehicle Restraint Systems are designed with the majority of road users in mind, i.e. cars, vans and trucks. However, motorcycles are not given sufficient consideration in the design and placement in road infrastructures and traffic mix.⁷
- This is supported by the “National Agenda for Motorcycle Safety.”⁸ In this document, the authors claim that “Many roadside barriers designed to retain cars and reduce injuries to automobile occupants are deadly to motorcyclists who collide with them. Wire-rope barriers are one example, but a motorcycle or the body of a fallen motorcyclist can also strike portions of other barrier designs in ways that an automobile cannot, causing severe injuries”.
- The advantages of wire rope barrier systems have been advocated through concepts such as risk compensation theory and other factors in order to favour this Vehicle Restraint System. Such factors include visibility at junctions, post-impact behaviour and even snow drifts.

³ CorrOcean: Provider of monitoring technology systems, services and products. Links to computer simulations: No protection: http://www.nmcu.org/av/rider_no_protection_right_view.mpg With protection: http://www.nmcu.org/av/rider_with_protection_right_view.mpg

⁴ LIER: Laboratoire de l'INRETS pour l'Equipement Routier

⁵ Department of Transport and Regional Services Australian Transport Safety Bureau : Motorcycle and Safety Barrier Crash-Testing: Feasibility Study: the greatest perceived concern for motorcyclists with respect to WRSBs is their potential to induce injuries through the so called 'cheese-cutter effect'...

⁶ Report on Motorcycle Safety by European experimental vehicles committee (12/1993): Identifies support posts of safety fences and barriers as particularly aggressive to motorcyclists, and recommends that consideration be given to providing energy absorbing surface for these in locations where there is a likelihood of motorcycle impacts.

⁷ Final report of the Motorcyclists & Crash Barriers Project 1.2. No mention of motorcycles or motorcyclists is made in EN 1317. The European homologation procedure for crash barriers.

⁸ <http://www.nhtsa.dot.gov/people/injury/pedbimot/motorcycle/00-NHT-212-motorcycle/toc.html> Chapter: Environmental Factors: Roadway Characteristics

- The risk compensation theory is highly complex but invalid in this context because risk compensation presumes that if individuals are protected by devices such as airbags or seat belts in a car, or protective leathers and a helmet on a motorcycle, there will be a propensity to take more risks. So in this context, it is difficult to comprehend how wire rope barriers could be perceived as risk compensatory, simply because wire rope barriers are *post* accident protection against injury.
- Assuming that wire rope barriers are actually used at junctions, the issue of visibility is incomprehensible and the reason for this is because the average height of other Vehicle Restraint Systems e.g. solid steel beam barriers can easily be overviewed by trucks, vans and the average car. The only type of vehicle which could be subject to restricted visibility would have to be a very low vehicle such as a sports car. Other Vehicle Restraint Systems at junctions are either tapered at the extremities towards the ground or placed far back enough from the junction so that visibility is maintained.
- In our view the more relevant problems are overgrown vegetation, angles of junction design, positioning of road furniture such as signposts, inappropriate vehicle design (e.g. A pillars) which inhibits the clear vision of motorcyclists by drivers and finally inadequate road awareness.
- It is MAG's view that snow drifts are less of an issue for motorcyclists in this context, because the possibility of motorcyclists riding in a snow storm would be exceptionally rare in the UK. In these climatic conditions, snow drifts would be least of their problems.
- In consideration of the type of injuries caused by the posts of any Vehicle Restraint System to a motorcyclist, the issue of post-impact behaviour is completely irrelevant for motorcycles.
- A common position taken by road safety analysts⁹ is that continuous smooth surface Safety Barriers do not present the same aggressive hazard to motorcyclists. Bearing in mind riders being impacted or impacting objects, such as other vehicles.
- The fitment of "motorcycle-friendly" secondary rails to existing Vehicle Restraint Systems is seen by riders' organizations as the most advantageous preventive method for riders to avoid hitting exposed posts.
- MAG UK believes that the fitting of addition secondary rails should not alter the risk factor for other road users.

Therefore MAG UK takes the position that all current Vehicle Restraint Systems must meet the same standard of tests for motorcyclists for central reservation protection as applied to all other vehicles.

⁹ Motorcycle safety: a scoping study (2003) (UK) Motorcycles and Roadside Safety Hardware Malcom D Macdonald TRL(2002) Referenced in Motorcycles and the Road Environment Rhod Pearson Road Safety Officer Motorcycle Riders Association Western Australia Gibson and Benetatos (2000), (Morgan and Ogden, 1999).

Progress Europe

FEMA

- “The Road To Success”¹⁰ which lists examples of best practice on the provision of motorcycle friendly crash barriers in Europe has been produced by the Federation of European Motorcyclists Associations (FEMA)¹¹.
- The document will supplement the FEMA “Final report of the Motorcyclists & Crash Barriers Project”¹² which was supported by the Directorate General for Energy and Transport of the European Commission.
- The aim of the document is to draw conclusions and recommendations on how to improve motorcyclists’ safety regarding Vehicle Restraint Systems.
- The document will ultimately assist politicians, road authorities and motorcyclists’ organisations to improve motorcyclists’ safety.
- The document seeks to have motorcycles and riders included in specifically designed test procedures within the European homologation procedure EN1317 for Vehicle Restraint Systems crash barriers.

Partnership

Several European road authorities in conjunction with riders groups have made reference to the problems, solutions and improvements that can be made regarding Vehicle Restraint Systems.

- One example is the riders’ organisation NMCU. In consultation with Statens vegvesen, the Norwegian Public Roads Administration has lead to the publication of a manual on motorcycle Safety, “MC Safety: Design and Operation of Roads and Traffic Systems”¹³ with a specific chapter on “Guard Rails”.
- The NMCU is also engaged in an ongoing fight to have existing cable barriers removed and replaced by more "motorcycle-friendly" Vehicle Restraint Systems, such as concrete barriers or steel beam barriers fitted with a secondary rail.
- MAG Ireland is fighting with its road authorities at the increased fitment of wire rope barriers.
- SMC the Swedish Motorcyclists Association has organised cable barrier demonstrations.
- FNM Portugal produced a hard hitting video¹⁴ to underline the fact that crash barriers can kill motorcyclists. Stating that ten percent of riders that collide against a rail, die.

¹⁰ <http://www.fema.ridersrights.org/crashbarrier2005/index.html>

¹¹ FEMA represents twenty two riders’ organizations in the member states of the European Union.

¹² <http://www.fema.ridersrights.org/crashbarrier/index.html>

¹³ http://www.nmcu.org/publ/vegdir_handbok245/handbook245e.pdf 511kb

¹⁴ http://www.fema.ridersrights.org/crashbarrier/movie_crashbarrier.MPG over 5mb

Other riders' organisations in Europe¹⁵ have organised successful campaigns against unfriendly motorcycle Vehicle Restraint Systems and also persuaded road authorities in the fitment of various types of secondary rails and post protection devices to existing Vehicle Restraint Systems.

MAG UK does not endorse any type of Vehicle Restraint System or the manufacturer of any of these systems.

A Success Story

The most proactive riders' organisation in Europe regarding the fitment of motorcycle friendly secondary rails has been the Motorrijders Actie Groep Netherlands (MAG Netherlands).

- The Netherlands is divided into 12 provinces and one province, Utrecht agreed to work with MAG Netherlands by looking at the provincial roads through the eyes of a motorcyclist.
- Utrecht, has almost 1.2 million inhabitants and 33.000 motorcyclists and is responsible for 383 kilometres of provincial roads.
- MAG Netherlands and the authorities from Utrecht investigated all the existing guardrails and identified 16 locations where guardrails could be dangerous to riders and where secondary rails could be fitted.
- The secondary rail developed by Dutch guardrail company Prins Dokkum B.V. uses an overlapping steel sheet system fixed to the existing safety barrier to prevent motorcyclists from colliding with the support posts. The system is fitted within a short period of time and does not affect the performance of the existing safety barrier.
- The first secondary rail was fitted in 2003 and the total cost of the project was €100.000.
- Similar to the UK responsibilities and funding for roads is divided between local and national authorities, only one motorcycle friendly guardrail has been placed on a national road.
- When the Dutch Transport Minister stated that, "I have almost 400 million euro available for regional traffic safety projects", MAG Netherlands started a national campaign for the funding of motorcycle friendly secondary rails.
- To support the campaign a petition to persuade the government to allocate funding to a guardrail project was circulated to motorcyclists, over 22,000 signatures were collected. The petition was then presented to the transport committee of the national parliament.
- The parliament is now discussing the plans for the future of Dutch roads and mobility with the minister. MAG Netherlands is working with members of parliament to make sure that the motorcyclist's voice is heard. In a recent letter to the parliament the

¹⁵ MAG - Austria, FFMC - France, Kuhle Wampe and BU – Germany, FNM – Portugal, MAG – Belgium, LMI – Luxembourg.

minister finally stated that serious attention is needed and steps will be made to improve crash barriers.

- MAG Netherlands has also been successful in promoting the dangers of wire rope barriers leading to the removal of wire rope barrier systems and preventing new wire rope barriers being fitted to the road infrastructure.

The UK

In August 2004 the Advisory Group on Motorcycling (AGM) published its Final Report to Government. The report contained several references to Vehicle Restraint Systems.

- The Highways Agency reported that the Transport Research Laboratory (TRL) had undertaken *some evaluation* of safety fences but that the current conclusion was that wire rope barriers are no more of a risk than other types of post and beam barriers.
- TRL also reported that there is inadequate information about the impact effects of motorcyclists with concrete, post and beam and wire rope safety barriers further stating that that the harmful items are the exposed posts of safety barriers, irrespective of their other components.
- The final report stated that, “Wire rope safety barriers fully meet the requirements of the European product standard for Road Restraint Systems (BS EN 1317)”
- The Highways Agency reported they intend to raise the issue of motorcycle and Vehicle Restraint Systems safety at the EN1317 CEN Standards Committee to prompt discussions about the merits of adopting safety barrier post protection measures as an integral part of the EN1317 standard.
- Extending the scope of EN1317 should provide a standard for ‘add on’ protective devices for the benefit of motorcyclists enabling them to be developed and used in highway improvement schemes.

MAG UK welcomes the position by the Highways Agency which calls for the inclusion of “Motorcycle Friendly” devices in the EN 1317 standard.

In April 2005 the Institute of Highway Incorporated Engineers (IHIE)¹⁶ published its “Guidelines for Motorcycling” to assist highway and traffic engineers in delivering a safer and more motorcycle friendly road environment. The guidelines mention safety barriers in the chapter on “Road Design and Traffic Engineering”.

- Pending further research it seems that retro-fitting impact migration measures to posts and some means of preventing dismounted riders from passing under rails would improve secondary safety for falling riders in safety barrier collisions.

MAG UK’s focus regarding EN 1317 is not merely to extend the scope of the standard but to have specifically designed test procedures for motorcycles and motorcyclists included within the European homologation procedure for Vehicle Restraint Systems and Safety Barriers.

¹⁶ www.ihie.org.uk

Rethinking Crash Barriers in the UK

In 2004 the Highways Agency implemented a proposed scheme for provision of a motorcycle friendly barrier system to supplement an existing safety barrier, after several accidents which included fatalities, at the A2070 Cloverleaf Junction in Ashford, Kent.

- In conjunction with InterRoute and installers Highway Care Ltd, the Highways Agency identified the “Bikeguard” system from Germany as the system best suited for the scheme.
- Bikeguard, used extensively throughout Europe consists of an overlapping steel sheet system fixed to the existing safety barrier to prevent motorcyclists from colliding with the support posts. The main advantage is that the support posts do not project beyond the top of the existing safety barrier.
- The perceived safety benefit of the Bikeguard barrier retention system is in relation to the loss of control by a motorcyclist and collision with the barrier retention system. It is viewed that injuries with the Bikeguard system fitted would be less severe than from a collision with the safety barrier support posts.
- Analysis of Accident Statistics since the installation of the Bikeguard barrier retention system has highlighted that no personal injury accidents have occurred.
- There is circumstantial evidence that a motorcycle impacted with the Bikeguard barrier retention system without damaging the original barrier though no accident report has been logged by Kent Police.
- Requests have now been received from other Highways Agency agents for details about Bikeguard, with the view of further installation of the product at similar locations within the Highways Agency network.
- Within the Highways Agency Area ‘4’, the installation of the Bikeguard barrier retention system is being investigated for locations where there are substandard radius slip roads.

The fitting of the Bikeguard system designed by SGGT in Germany (which has type approval under DIN EN 1317) is a bold step in *highway engineering terms* and the system is similar to that fitted and produced in the Netherlands by Prins Dokkum B.V and HIASA in Spain.

Although there are other designs of motorcycle friendly secondary rails, this type of secondary rail design appears to have been accepted by road authorities and is supported by MAG UK

This highlights the urgency of standards for secondary rails to be included in EN 1317 so that the locations of Vehicle Restraint Systems that present a hazard to riders from exposed metal posts can be located and riders protected from injury.

Motorcycle User Casualties and Crash Barriers

Motorcycle User casualty figures supplied by the Department for Transport (DfT) (Table 1) are broken down into two categories.

The first category highlights where the object hit by a motorcycle user was a Central crash barrier and the second where the object hit by a motorcycle user was a near/off side crash barrier, there is no description of the type of barrier or the cause of the collision.

In 2003, the last year in which full casualty figures were made available, there were 109 slight/serious/fatal motorcycle casualties where the rider hit the central crash barrier and 144 slight/serious/fatal motorcycle casualties where the rider hit the near/offside crash barrier.

From 1999 to 2003 the total number for slight/serious/fatal motorcycle casualties hitting both the central crash barrier and the near/offside crash barrier was 1,271.

Fatalities in the same period were 142.

In 2003 there were 36 fatalities due to crash barrier impacts out of a total of 693 fatalities. Therefore 5.2% of all fatalities were crash barrier impacts.

Table 1: Motorcycle user casualties where the object hit was a crash barrier: by severity: 1999-2003 (DfT October 2004)

| | Year | <u>1999</u> | <u>2000</u> | <u>2001</u> | <u>2002</u> | <u>2003</u> |
|-----------------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
| Casualties | | | | | | |
| Central crash barrier | Fatal | 12 | 15 | 17 | 9 | 19 |
| | Serious | 50 | 55 | 50 | 45 | 48 |
| | KSI | 62 | 70 | 67 | 54 | 67 |
| | Slight | 38 | 43 | 37 | 41 | 42 |
| | TOTAL | 100 | 113 | 104 | 95 | 109 |
| Near/Offside crash barrier | Fatal | 8 | 14 | 7 | 24 | 17 |
| | Serious | 74 | 70 | 67 | 69 | 65 |
| | KSI | 82 | 84 | 74 | 93 | 82 |
| | Slight | 72 | 64 | 64 | 73 | 62 |
| | TOTAL | 154 | 148 | 138 | 166 | 144 |

Two wheeled motor vehicle users casualties 2003

Killed 693
 Seriously injured 6,959
 Slightly injured 20,759
 All casualties 28,411

The Department for Transport (DfT)¹⁷, "Tomorrow's roads –safer for everyone April 2004" is aligned with the European Commission's 3rd European Road Safety Action Programme (RSAP).

¹⁷ www.dft.gov.uk

The aim for road safety in Europe and the UK is to review road safety strategy and set a target to reduce the number of people killed or seriously injured (KSI) in road accidents. In the UK the target set is for a reduction of 40% by 2010.

MAG UK concludes that in this context the fitting of secondary barriers would see a reduction of motorcycle fatalities and injuries in real terms.

Furthermore, MAG UK believes that the methodologies used by both national and EU government of determining accident rates are conceptually biased.

Finally, in this context MAG UK considers that the determination to quantify a life in monetary terms to justify legislation on safety barriers through cost benefit analysis is a reflection of the changes from the European Commission where human life is simply calculated as a target or commodity.

MAG Action

That the decisions by road authorities to install Vehicle Restraint Systems should take into consideration the safety of motorcyclists in order that:

1. Existing steel beam barrier systems are fitted with "motorcycle-friendly" secondary rails.
2. The Location of existing steel beam barrier systems where they offer a hazard to motorcyclists should be identified by road authorities.
3. Existing wire rope barriers be removed and replaced by "motorcycle-friendly" Vehicle Restraint Systems or Safety Barriers.
4. The placement of Vehicle Restraint Systems are not a greater danger than the obstacle they are intended to protect.

That UK government official's press for European legislators to make changes to EN1317 CEN Standards so that:

1. All current Vehicle Restraint Systems meet the same standard of tests for motorcyclists for central reservation protection as applied to all other vehicles.
2. Motorcycle-friendly secondary rails and all other forms of post protection devices are included in the standards of tests for other vehicles.

The aim of MAG UK is to improve the safety of Vehicle Restraint Systems thus reducing the potential for injury and death of motorcyclists when impacting these systems.

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Information Links

- FEMA “The Road To Success”
<http://www.fema.ridersrights.org/crashbarrier2005/index.html>
- MAG “Vehicle Restraint Systems, Safety Fences, Crash Barriers, Motorcyclists July 2005 1:2”
www.network.mag-uk.org/crashbarriers2005/MAGcrashbarrier2005.pdf
- MAG Action Document
<http://www.network.mag-uk.org/crashbarriers2005/MAGactioncrashbarriers.pdf>
- FEMA “Final report of the Motorcyclists & Crash Barriers Project”
<http://www.fema.ridersrights.org/crashbarrier/index.html>
- Computer simulations:
No protection: www.nmcu.org/av/rider_no_protection_right_view.mpg
With protection: www.nmcu.org/av/rider_with_protection_right_view.mpg
- FNM Portugal video
http://www.fema.ridersrights.org/crashbarrier/movie_crashbarrier.MPG over 5mb.
- Links to video clips in the public domain. Showing the interaction of other vehicles with wire road systems.
www.brifenusa.com
www.brifen.co.uk/video.html
<http://safence.com/Standarde.htm>

MAG has copies of the CD which outlines the test procedures by the Dutch guardrail company Prins Dokkum B.V. on their motorcycle friendly crash barrier system.

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