Safety Barriers and Motorcyclists

by G L Williams, J K McKillop and R E Cookson

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SAFETY BARRIERS AND MOTORCYCLISTS

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Executive Summary

For a number of years, the issue of safety barriers has been raised by a number of motorcyclists' groups throughout Europe as they consider the barriers to be designed for the safety of cars and other road users, but feel that their safety would be severely compromised if they were to impact such devices.

In particular, the wire rope safety fence has been identified by such groups as having a greater potential to cause injury to motorcyclists, than other types of safety barrier.

Whilst there has been much work undertaken to examine the impacts between safety barriers and motorcyclists, much of the work dates back to the mid 1980s. Due to a requirement from the European Commission that motorcyclists' safety be more prominent in the minds of National Authorities, more recent work has begun in this area, but is not at the stage where it can be published.

Accident statistics from Great Britain between 1992 and 2005 (contained in STATS19), and from other sources collated as part of the literature survey have shown that motorcyclists are at a greater risk of injury during an accident than other road users. In Great Britain, 27.2% of motorcyclists involved in an accident are likely to receive fatal or serious injuries, compared to 12.8% of car occupant. During impacts with safety barriers, motorcyclists have received fatal injuries in 10.8% of impacts, 45.1% suffering serious injuries and 44.1% slight injuries. If this is compared to the average accident severity statistics for all road accidents (1.4% fatal injuries, 12.9% serious, 85.7 slight injuries), the severity of motorcyclists' impact with safety barriers is clear.

A further examination of the STATS19 data has also shown that although motorcyclists account for only 1.1% of traffic on major roads within Great Britain, they account for 18.6% of all fatal safety barrier casualties. This again highlights the severity of such impacts. The majority of such accidents occur during daylight hours, with fine weather, and on a dry road, with the majority of those injured being aged between 20 and 29.

Of those fatally injured, the motorcycle is likely to be between one and five years of age, with an engine size over 1000cc.

In general, research has highlighted that although the main concern of many motorcyclists' group was originally the "cheese cutter" effect of wire ropes, this has not been witnessed within accidents. Instead it is the posts of the safety fence system which seen as the greatest area of concern, as impacts with the posts often lead to major head and limb injuries. In three fatal impacts with wire rope safety fence examined in England between 1992 and 2005, all of the casualties suffered injury as a result of an impact with the safety fence posts, not with the ropes.

However a comparative study of the severity of safety barrier impacts, by barrier type, has shown that in England there is a slightly increased risk to motorcyclists from impacts with wire rope safety fence (a 66.7% risk of serious or fatal injuries from wire rope, compared to 58.7% for all barrier types). In Scotland this risk is greatly increased (a 100% risk of serious or fatal injuries from wire rope, compared to 58.3% for all barrier types). However it should be stressed that the number of impacts between motorcyclists and wire rope safety fences is small (less than 1 impact per year).

For fatal accidents in England and Wales, impacts with safety fence posts account for 32% of all fatal injuries, with the rail accounting or 40%. Such impacts with posts then result in multiple injuries in 38% of cases, of which 90% involved severe trauma to the head. In 90% of cases a helmet was worn at the time of the impact, although half of the helmets were removed by the force of the impact.

Due to the threat posed by impacts with safety fence posts, a number of manufacturers have designed protection systems designed to reduce the severity a motorcyclists' impact with a safety barrier. These devices fall into one of three categories; individual post protector, a secondary rail, or a barrier designed with motorcyclist safety incorporated. Of these it is the secondary rail which is currently being trialled in a number of locations within England, and is the most common design being promoted. Testing, to either French or Spanish protocols, has seen head impact criterion (HIC) values

(recorded by dummies accelerated on sleds) of less than 300 – much less than the maximum value of 1000. Hence their performance in reducing the severity of head impacts has been proven. However the use of such devices is recommended with a little caution as testing in Germany has shown that whilst the systems are effective at reducing the severity of motorcyclist impacts, they can cause other vehicles (such as cars) to ‘climb’ the barrier – however these tests were still deemed to meet the requirements of the European testing requirements, EN1317. Whilst EN1317 does not include any requirement for the testing of safety barriers with motorcycles, the European Technical Committee (TC) 226 has initiated work on developing a harmonised European testing standard to evaluate motorcyclist protection systems.

Much of the work current being undertaken has examined the consequences of a motorcyclist impacting the safety barrier if sliding across the carriageway and then impacting the posts. However an examination of fatal incidents occurring in England and Wales has shown that 47% of accidents occur when the rider is still on the motorcycle – only 37% of the riders were sliding across the carriageway prior to impact, with 47% of riders rolling and 12% not in contact with the ground. As a result, much of the work currently being undertaken to reduce the severity of motorcyclist impact with safety barrier posts is commendable, but it may not be addressing the majority of incidents where the motorcyclist impacts the barrier whilst still on the bike. It is this area in which researchers and testing institutions should concentrate their efforts in the future as there is only very limited information available in this area at present.

Implementation

The risk of motorcyclists receiving fatal or serious injuries during an impact with a safety fence post is high; although the number of those injured each year from such impacts on major roads is relatively low (an average of 182.8 per year in Great Britain, of which 12.4 per year occur in Scotland). Of these, an average of 20 motorcyclists per year will received fatal injuries – two per year in Scotland.

An examination of the type of safety fence impacted has shown that, particularly in Scotland, there is a disproportionately high percentage of motorcyclists being killed or seriously after impacting a wire rope safety fence than other types of safety barrier, although the actual number of impacts is low (less than 1 per year). This issue should be addressed, and it is felt that the most effective approach to this would be to first better understand the circumstances surrounding these particular instances.

There are a number of other countries which require the consideration of motorcyclists when installing or designing for the layout of such devices. Some countries giving guidance and/or requirements for the locations where motorcyclist protection devices should be installed, and these are located mostly on bends.

An examination of the location of fatal impacts between motorcyclists and safety barriers in Great Britain has shown that median barrier accidents are most likely to occur on left hand bends with a large radius, whilst verge barrier impacts are more likely to occur on right hand bends with a tight radius. However a disproportionately high number of such impacts appear to have occurred on slip roads and at roundabouts. If the number of casualties per year were considered to be sufficient that the retrofitting of devices to provide additional protection to motorcyclists is warranted, it is recommended that it is these areas where the protection would be most beneficial. This would be in addition to any incident ‘black spots’ which may exist.

1 Introduction

For a number of years, the issue of safety barriers has been raised by a number of motorcyclists' groups as they consider the barriers to be safe for cars and other road users, but feel that their safety is severely compromised if they were to impact such barriers.

In particular, the wire rope safety fence has been identified by such groups as having a greater potential to cause injury to motorcyclists, than other types of safety barrier.

Wire rope safety fences are a type of road furniture typically consisting of four metal cables woven between supporting metal posts, which are anchored in the ground beside the carriageway of a public road. They may be installed at the outer edges of the road, the central reservation of a dual carriageway, or both.

In order to examine these fears, a literature review has been completed to examine the research conducted to date examining the interaction between motorcyclists and safety barriers. This includes an examination of the typical interaction modes between the motorcyclist and the safety barriers, as well as examining the accident statistics reported from such impacts throughout the World.

The review also identified a number of proprietary products which are currently available to reduce the severity of an impact between a motorcyclist and a safety barrier, and the testing protocols currently in place to harmonsise this testing.

A collation and review of STATS19 accident data relating to motorcyclist and safety barrier impacts in Scotland, England and Wales between 1992 and 2005 has also been completed to examine the number and severity of such impacts, and to identify any factors which may be common between such accidents.

Unfortunately the STATS19 data do not contain any details regarding the specific safety fence type or the mechanism of the accidents. As a result, police files relating to fatal incidents occurring in England and Wales have also been examined to identify these factors. These data have then been collated and combined to identify common factors occurring in such fatal incidents.

In order to identify the barrier type in incidents of all severity occurring on Highways Agency roads, two methodologies were undertaken; the first was to contact each of the local Highways Agency's Maintaining Agents and request the type of barrier installed at incident sites for those incidents occurring in 2005; the second approach was to identify the location of wire rope safety fencing on the Highways Agency Network, and cross-reference this with the location of motorcyclist to safety barrier incidents. In addition, comparative data identifying the barrier type at the site of a motorcyclist to safety barrier impact have been supplied by Transport Scotland for incidents occurring between 1990 and 2005.

2 Questionnaire

In order to ascertain the current level of understanding and issues surrounding the use and implementation of motorcyclist-friendly devices, a questionnaire was circulated to manufacturers, research establishments, test houses, Governmental Departments and motorcycling groups with Europe.

The results of this questionnaire are tabulated in Appendix A.

Results were returned from thirty different bodies; five manufacturers, three research establishments, two test houses, two Governmental bodies, and eighteen motorcycling groups.

In each case, where reference to additional literature and information were supplied, these have been incorporated into the literature review contained within Section 3 of this report.

In summary, the results of the questionnaire indicated that whilst research was currently being conducted into motorcyclist safety, some of this was not yet at a publishable stage.

The questionnaire also revealed that testing of motorcyclist-friendly systems was being undertaken within Europe, mostly to the requirements of the LIER or Spanish testing procedures (see Section 4). In those cases where information and test results for particular motorcyclist-friendly systems were provided, these are detailed within Appendix B.

The questionnaire also revealed that motorcycle-friendly devices are currently being installed in thirteen of the eighteen countries responding (these being Austria, Belgium, England, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain and Switzerland). Five of the responding countries namely, the Czech Republic, Denmark, Greece, Ireland and Sweden, do not currently implement such systems.

Of the thirteen countries in which motorcyclist-friendly devices are used, only five have National regulations documenting their requirements for the use of such systems, these being Belgium, England, France, Germany and Portugal. In those cases where requirements exist, attempts have been made to collate these requirements and include them within this report.

3 Literature Review

Wire rope safety fences were often seen as a hazard by motorcyclists and motorcycling groups such as the British Motorcyclists Federation (BMF) and the Motorcycle Action Group (MAG) who often referred to them as 'cheesecutters' (Double-Tongued Dictionary, 2007) (MAG 2006), since they feel that there is a risk of serious injury being caused during an impact with the longitudinal ropes used by the system. However as will be seen in the preceding sections, it is now the posts of the safety fence which are largely considered to be more hazardous by the motorcycling groups, researchers and industry experts alike. Hence, the problem is not just limited to wire rope safety fence installations, but extends to all safety barrier installations, independent of their type.

The Norwegian Public Roads Administration has also pointed out that it is not just safety barriers which include posts in their design which could be injurious to motorcyclists during an impact. In their new vehicle restraint systems standards, Handbook 231 (2003), roadside features such as full-height terminals and passively safe lighting columns and poles are also identified as potential hazards.

3.1 Issues Specific to Wire Rope Safety Fences

As previously stated, wire rope safety fences were often seen as a hazard by motorcyclists and motorcycling groups who often referred to them as 'cheesecutters' since they feel that there is a risk of serious injury being caused during an impact with the longitudinal ropes used by the system.

However it is worthy of note that at the 2008 Annual meeting of the Transportation Research Board (TRB) International sub-committee AFB20(2) in the USA, where the topic of motorcyclist and safety barrier impacts was discussed, presentations on incident data were presented from the UK, Italy, Spain, France and Sweden. In each case it was stressed that the 'cheese-cutter' effect had not been witnessed within the respective countries.

Furthermore a report by Monash University (2003) stated that there was no record of this occurring in Sweden despite wire rope barriers being present on some 900km of Swedish roads. These findings follow a similar pattern to those of Duncan et al (2000) who have stated that there is no substantial evidence to show that wire rope safety barriers pose a greater risk to motorcyclists than the objects from which they are designed to shield the road user, such as trees, posts, or oncoming traffic. Duncan et al add that there is no evidence of the "cheese cutter effect" during injury events.

In many European countries like Sweden, road authorities are installing wire rope safety fence. These can be placed both in the verge and on the median of both low and high speed roads.

Because of the relative low initial cost and low impact severity (for car occupants, as observed during certification testing) of the wire rope systems, more countries are considering their use, although the actual installation lengths on national motorways and trunk roads remains relatively low. For Highways Agency roads, the proportion is approximately 1.3% of all barrier installations (from the HAPMS system, 2007), and a similar percentage has been reported by the Australian State authorities (ATSB, 2000).

However, some European countries, like Belgium, are strongly opposed to the use of wire rope safety barrier, and Denmark even removed several thousand metres of existing wire rope because it was considered unsafe (FEMA, 2005). A report from the Norwegian Motorcycle Union (2006) also reports that the Dutch Parliament decided to ban wire rope barriers.

However the Australian Transport Safety Bureau have stated, in their report of 2000, that the effect of banning wire rope safety fence could be detrimental to overall road safety, for the following reasons:

- The advantages of wire rope barriers are: they can have superior containment properties; they can cause less damage to vehicles and their occupants; they can be easier and safer to repair; and they can be cheaper to install. While they are not suitable in many situations, wire rope systems add significantly to the range of treatment options available to traffic engineers.
- If wire rope barriers were banned, the substitution of more rigid barrier types could result in a net increase in casualties among car occupants.
- If wire rope barriers were banned, the cost of installing alternative treatments would be greater in many cases. This could require an increase in overall road funding levels or a reduction in the number of treated sites. The latter would result in a net increase in road user casualties.
- If single-beam guard rails as well as wire rope were prohibited, the effects described above would be significantly compounded.

Hence this demonstrates that any decision to limit or ban the use of wire rope safety fence should be considered carefully, and should consider the consequential effects on all road users, independent of their mode of travel.

3.1.1 The Effect of Wire Rope Safety Fencing on Motorcyclists' behaviour

A Swedish study (Pieglowski, 2005) detailed the results from a questionnaire, placed on the website of the Swedish Motorcyclists' Association (SMC), examining their perception of the hazards presented by wire rope barriers. A total of 346 riders responded.

They were mostly male, outnumbering female in the ratio 9:1. The results from the questionnaire showed that:

- More than 97% of the respondents had not been involved in an incident with a wire rope barrier, thus 3% had, and survived the encounter.
- More than 74% claimed to maintain speed regardless of the presence of such a barrier on the road.
- 63% of riders said they increased their distance from a wire rope barrier on becoming aware of it.
- About 69% felt less secure when riding alongside safety barriers, but these were mainly men aged 25-30. On the other hand, some 30% of women riders claimed to feel more secure.
- More than 75% of the respondents feared colliding with the barrier, in contrast to 18% who felt protected from head-on collisions.
- More than 55% of the respondents said that their choice of travel routes was not influenced by the presence of wire rope barrier.
- The remainder said that it was faster travelling by alternative routes.

Hence the results show that the presence of wire rope safety fence will have some effect on approximately 35% of riders, although a reduction in travelling speed, or an increase in rider awareness (caused by the use of wire rope, or any other barrier type) may have a positive effect of the overall safety of the road.

3.2 Typical Accident Scenarios

In order to improve the safety of motorcyclists when impacting a safety fence, it is important to understand the circumstances surrounding such incidents. As a result, these issues can then be examined and addressed. The subsequent sections examine the following areas of motorcyclist to safety fence interaction, to identify any contributory, or consistant elements:

- Incident Location
- Cause of Injury
- Mode of Interaction between Motorcyclist and Safety Fence
- The Use of Concrete Barrier
- Likely Injuries and Injury Causation

A review of available incident data is also made regarding motorcyclist to safety fence impacts from around the World, both those including wire rope safety fencing, and safety fencing in general. A detailed review of such incidents on the Highways Agency's Network is presented within Section 6 of this report.

3.2.1 Incident Location

A study by Rogers and White (1995) found that among fatal motorcycle crashes classified as 'off-path, hit object', 78% occurred on curves. Whilst these data do not exclusively include incidents including safety barriers (i.e. they will include impacts with all roadside furniture), it does indicate that there is a high proportion of impacts on bend.

Similarly, a detailed examination of 1996 Australian coroners' records found that 79% of off-path crashes occurred on curved road sections.

Furthermore, a report by Quincy et al (1985) investigated accidents occurring on 940 km of highway in France over a three year period. It concluded that there was a concentration of motorcyclist to barrier incidents on access roads and interchanges.

In addition, a review of 240 motorcyclist impacts with safety fences on non-urban roads in America, by Brailly (1998) found that the most frequent location of these accidents was on tight bends with a radius of typically less than 250m. Accidents on bends took place mainly on the outside lane irrespective of the direction of the bend (left or right hand) and irrespective of the road category. However, accidents with barriers were far more frequent on right-hand than on left-hand bends irrespective of the road category.

All four of these reports do, therefore, indicate that there appears to be evidence to suggest that there is a high proportion of such incidents occurring on bends and hence, if additional protection was to be provided it may be these locations where additional protection would be most beneficial.

Due to their cost, the prioritisation of adding additional motorcyclist protection to safety fences is an issue which has been examined and reported by Domhan (1987). He examined the cost/benefit of two possible types of protection:

- covering the individual fence posts with an energy absorbing material and
- fixing a second rail to the original barrier.

Results showed that equipping all barriers with additional safety features would incur high costs, which are unlikely to be outweighed by the saving in injuries. This is true for both of the above types of safety measure. However, if account is taken of the fact that motorcycle accidents are likely to be concentrated on certain sections of road and the improvements are implemented only at these points then the results of Domhan's study change considerably. It is known that between 20% and 40% of all motorcycle accidents with heavy bodily impacts into a barrier are confined to 10% of the barrier again, typically on bends. If this 10% can be identified and then only this part of the barrier is provided with protective material then the benefit becomes greater than four times the cost of the protection.

3.2.2 Cause of Injury

Macdonald (2002) notes that it is now generally recognised that the actual cause of motorcyclist injury with a safety fence is more likely to be the supporting posts than the longitudinal elements of the safety fence, because the motorcyclists will invariably have become detached from their vehicle and sliding along the carriageway at the moment of impact. These hazards will be present whether the posts are supporting wire ropes or steel beams.

These findings are confirmed by Koch and Brendicke (1989) of Germany and Quincy et al (1988) of France, Duncan et al (2000) of the USA, and Sala and Astori (1998).

This is supported by an investigation by Ouellet (1982) of 900 motorcycle accidents in California which showed that the serious injuries suffered by motorcyclists impacting with safety fencing were caused by the exposed portions of posts. However Ouellet found that the majority of the riders struck the fence whilst still upright on the motorcycle. A typical shallow angle impact initially causes little injury due to the low speed component at right angles to the traffic flow and beam, although the edges of the beam can cause lacerations. However after striking the barrier, the rider begins to separate from the bike and tumbles onto the exposed tops and lower portions of the posts, resulting in more direct, high speed impacts.

The sharp edges and corners of the posts concentrate impact forces exacerbating the potential for injury. This has been supported both by dummy tests (Domhan, 1987; Quincy et al, 1988) and real world crash data (Transport Canada, 1980). Ouellet (1982) suggests that the reasons for this are the rigidity of these objects and the velocity component perpendicular to the impacting surface being greater than in many other types of collisions.

The Norwegian Public Roads Administration (NPRA)'s Handbook 231 (2003), has also identified the top of the posts as being particularly hazardous for motorcyclists if they become dismounted from the motorcycle during an impact. This is a view shared by Gibson and Benetatos (2000) and Duncan et al (2000). As a result, the NPRA require that posts must not extend more than 1 cm above the top of the rail for any safety fence system installed on their roads. Posts which exceed this must be cut. In one fatal accident the NPRA report that a motorcyclist hit the top of the safety fence post and punctured a lung.

The height of the safety barrier system has also been identified as a potentially hazardous feature of barriers (Monash 2000), especially when riders hit the barriers while still on their motorcycle as there may be a hazardous environment on the other side of the barrier (for example, on-coming traffic or another item of roadside furniture such as a bridge pier). This is a concern, shared by Peldshus (2006).

3.2.3 Mode of Interaction between Motorcyclist and Safety Fence

In most of the barrier collisions investigated in a 2003 study by Monash University the rider was still on the motorcycle at the point of first impact. Additionally, in an examination of motorcycle crashes identified from 1996 Australian coroners' reports, only 23% involved the rider sliding before impact.

A recent report by Peldschus (2006) examining road user safety stated that barrier impacts occur in an upright riding position in about half of cases. Until now investigation work has mainly been focused on the other half, involving a sliding impact position.

Gibson and Benetatos (2000) examined the records of NSW fatal motorcycle crashes that occurred in 1998/99, and concluded that motorcyclists could impact a crash barrier after being thrown into the air from their motorcycle (two of the eight fatalities involving crash barriers), separate from their motorcycle and slide along the road into the crash barrier (one fatality) or impact a crash barrier whilst still on the motorcycle (three fatalities).

Further more, Quincy et al (1988) investigated impacts between motorcyclists and vehicle restraint systems occurring in the urban area of Paris between 1978 and 1979. The paper reported that in the 38 barrier impacts examined:

- 34% (13 cases) involved the rider impacting the barrier whilst still mounted on the motorcycle;
- 24% (9 cases) involved the rider becoming dismounted from the motorcycle and sliding along the carriageway before impacting the barrier;
- 42% (16 cases) involved barrier impact without sliding.

However evidence from Monash University, Queensland Main Roads representatives and the New South Wales police suggest that the vast majority of motorcyclist impacts with barriers involve riders sliding across (or otherwise traversing) the carriageway after becoming dismounted from their motorcycles.

MAG UK agree, reporting that that when a motorcyclist is involved in an accident or a fall they will generally separate from the motorcycle and slide along the road surface, with an initial speed equal to the speed of the motorcycle (MAG 2005). They highlight the fact that during this time the motorcyclist is at risk of impacting the 'roadside furniture', such as lamp-posts, sign-posts or barriers.

This view is shared by Duncan et al (2000) who found that the majority of motorcyclist impacts with barriers involve riders sliding across (or otherwise traversing) the pavement after leaving their motorcycles. Furthermore he found that typical impact angles are around 12°, though US and European test standards might involve impact of around 20-25° for general barrier testing, thereby capturing information on more severe crash scenarios.

A further report by Ouellet (1982) suggests that riders tend to impact barriers at shallow angles, however there is no data presented in their report to justify this statement.

Discussions between Monash University and the Queensland Main Roads representatives, Victorian authorities and the New South Wales police (Duncan et al, 2000) suggest that typical impact angles are relatively shallow (around 10 degrees).

Following on from this, Hell and Lobb (1993) and Otte (1994) have calculated that if a rider slides into a safety barrier at an angle of 15 degrees with a width of 45cm, the rider has a 70% chance of directly impacting a barrier post. The chance is still greater for riders sliding or rolling sideways or impacting at even shallower angles. They state that this is particularly undesirable given that impacts with posts were found to be the most likely to cause severe injuries than impacts with any other types of fixed object. This probability will obviously increase as the spacing between consecutive posts decreases and hence, post and rail safety fence systems with posts widely spaced could be considered to be less hazardous to motorcyclists. Conversely, systems with posts spread too far apart can have a detrimental effect on the containment and redirection of other vehicles, such as cars.

Gibson and Benetatos also concluded that the majority of fatal crash barrier impacts were at relatively shallow angles with respect to the crash barrier – five of the eight fatalities arose from impacts at an angle of 45 degrees or less. Decreasing the angle of impact with a barrier decreases the (perceived) risk of injury from impact with a concrete barrier, but increases the risk of impact with a barrier post from a W-beam barrier or a wire-rope barrier.

3.2.4 The Use of Concrete Barrier for Motorcyclist Protection

There is a widely held view within rider organisations that barriers with smooth longitudinal surfaces (such as concrete) are likely to be much less injurious to riders than other barrier types when in an impact (ATSB 2002). The New South Wales Motorcycle Council, for example, has stated that all road safety barriers should be smooth surfaced with an absence of exposed posts and sharp edges, and any W-beam fencing should have a second strip laid to the road surface to ensure that all sharp edges, exposed posts and gaps are covered.

The use of concrete barrier as a safer option for motorcyclists is agreed with by the Federation of European Motorcyclists' Associations (FEMA) who have stated that slip formed concrete barriers, are used far more frequently in Norway as a result of lobbying by the NMCU (Norwegian Motorcycle Union) and that a smooth concrete barrier is in itself 'motorcycle-friendly'. The increased safety of a concrete barrier for motorcyclists is also agreed with by Ouellet (1982) who examined these interactions in a US study.

Data from the New South Wales (NSW) fatal case study (Gibson and Benetatos, 2000) and a report by Duncan et al (2000) concur in the notion that concrete barriers are safer for motorcyclists than W-beam barriers when struck at shallow angles.

The same view is shared by Czajka (2000), who states that it is the absence of protrusions and the smooth surface of concrete barriers which makes them preferable to motorcyclists over other barrier types. However, adding holes or protrusions to this barrier type increases the possibility of vehicles or riders becoming caught on them, thus decreasing barrier safety performance.

Although the rigidity of concrete barriers is inherently hazardous in terms of not absorbing the force of impact, their continuous surface is preferable to the non-continuous surfaces of W-beam and wire rope systems at low impact angles. This is due to the fact that barriers with a continuous surface enable sliding and "soft" redirection of the victim and allow for greater distribution of contact forces over a large body area (Sala and Astori, 1998).

In addition, the use of concrete concurs with the approach recommended by Duncan et al (2000) who states that safety barriers should be designed with the aim of containment in mind, as long as the containment of the motorcyclist does not result in more severe injuries than would be sustained if the rider were to pass over, through or under the barrier.

The objection against concrete barriers has been due to the high initial costs, however in England, the use of concrete safety barrier is now mandatory for median barriers on roads with an AADT of over 25,000 vehicles per day, due in part to a review of the whole life costs associated with different barrier types. A study by the Australian Transport Safety Bureau (ATSB, 2000) has concurred with this, stating that concrete barriers are an economically viable option when whole of life costs are considered as lower continuing maintenance and repair costs quickly offset the higher initial concrete barrier installation costs.

3.2.5 Additional Information

In addition to the accident scenarios presented previously, additional background information regarding common motorcyclist to safety fence impact scenarios have been identified:

Firstly research by the Victoria Road Safety Division (VicRoads) reminds us that 'Motorcycles differ from other powered vehicles in that they lean to change direction... Designers should allow for angles of lean of at least 30 degrees.' To reduce the probability of an impact between a rider and roadside equipment.

Data from the Netherlands for incidents occurring between 1995 and 1998 has shown that there is an increased number of motorcyclist impacts with safety barriers during the warmer periods of the year. This is likely to be associated with a larger number of motorcyclists riding as a leisure activity during this time.

3.3 Likely Injuries and injury causation

Impacts with safety fence posts can cause serious injuries through deceleration of the torso, fracture of the extremities, or occasionally, decapitation. In addition, the jagged edges of beams or wire ropes provide numerous potentially lacerating surfaces which serve to accentuate rider injury risk (Duncan et al, 2000).

Studies have been made of the most likely areas of the body to be injured in motorcyclist to safety fence impacts. These are, in order, the legs, head, and thorax (Hell and Lobb, 1993). In motorcyclist collisions with fixed objects however, the chances of AIS2+ head, thorax and spinal injuries are increased far more than for other regions of the body - by over 50% for the head and over double for the chest and spine (Hell and Lobb, 1993; and Otte, 1994). This suggests that another factor behind the greater severity of injuries incurred by motorcyclists in barrier crashes may be that they are more likely to strike vital regions of the body.

A review of the European MAIDS accident data (URL) concurred, stating that incidents between safety fences and motorcyclists are likely to cause serious injuries to lower extremity regions of the body and spinal injuries, as well as serious head injuries.

Ouellet's (1982) research suggests that severe head injuries (AIS3+), are much more likely following a head impact with a crash barrier, than in head impacts with any other fixed objects in the roadside.

Domham (1987) considered the padding of a barrier face with some form of protective padding to improve motorcyclist protection, but found it to be neither practical or cost-beneficial, but covering the crash barrier support posts with energy-absorbing material can produce a clear reduction of injury severity. He reports that in comparable accident situations the injury severity could be reduced from AIS = 4 to AIS = 1 or 2 by the use of crash barrier protectors.

Jessel (unknown) has also examined the location of injuries typically sustained by motorcyclists during impacts with safety barrier. It states that typical types of injury sustained are:

- Fractures
- Open Fractures
- Serious internal injuries
- Amputations

The Jessel report then examines the effect of fitting individual post protection devices to the posts of safety barriers. It finds that the impact attenuators halve the impact deceleration, halve the impact force and double the impact time (in milliseconds). It continues that the biomechanical tolerance of deceleration for a chest impact is 600-800m/s^2. This figure was exceeded with the unprotected post (860m/s^2), but with the protected post, deceleration was only 472m/s2. This shows that the polystyrene protector can greatly reduce the body loadings and hence, the expected level of injuries sustained by the motorcyclist.

Further work in this area has also been carried out by Dr Georg Schmidt from Heidelberg University (1985) who impacted barrier posts with cadavers. The tests simulated an accident where a motorcyclist would be sliding on his back, feet first, at an angle of 15° against an I-profile barrier post. This type of post was used extensively throughout mainland Europe in the 1960s, 70 and 80s. Tests performed at 32 or 33 km/h resulted in an AIS of 4 without any additional protection, but AIS 1 or 2 with protection applied to the post.

Further work by Schnuell from the University of Hannover, reported by Uwe Ellmers (1994) has shown that sigma shaped posts under comparable conditions just cause bruising where as IPE-100 posts can cause fractures or amputations.

The use of sigma shaped posts instead of those with an I-profile is also supported by a report by Koch and Brendicke (1998) and this is the approach which is now being implemented extensively within mainland Europe. Within the UK, Z-shaped posts are more frequently used, however no research has been undertaken to examine the likelihood of injuries from posts with this profile.

3.4 Severity and Frequency of Incidents Involving Motorcyclists and Safety Fences

A detailed review of motorcyclist to safety fence incidents on the Highways Agency's Network is presented within Section 6 of this report.

A review of impacts with safety barrier types is given in Section 7 of this report for both Highways Agency and Transport Scotland roads.

Whilst it is acknowledged that impacts between motorcyclists and safety fences often result in disproportionately high severity injuries, Gibson and Benetatos have concluded from their work in 2000 that impacts with trees and telegraph poles were more likely to be identified as responsible for the fatal injuries incurred in motorcycle accidents than kerbs/culverts and barriers. Furthermore a Transport Canada study (1980) concluded that the most injurious types of objects for a motorcyclist to hit were, in decreasing order, posts, trees, poles, crash barriers and culverts/kerbs.

Research by the Australian Transport Safety Bureau (2000) has reported that motorcycle accidents generally appear to be comparatively rare in absolute terms, though this may be due to the low percentage of motorcycles in the vehicle fleet, in Australia estimated to be 0.5%. A review of statistics for the year 1995 in Britain indicated that motorcycle accidents accounted for only 4% of the impacts with safety fences but that these were only 0.07% of the total motorcycle accidents (BMF, 1995). Limiting the accident study to trunk roads reveals that approximately 3% of motorcycle injury accidents involved safety fences.

This rare occurrence statistic is concurred with by a review of European MAIDS accident data (URL) has stated that safety barrier accidents, though not frequent, present an increased danger to motorcyclists causing serious lower extremity and spinal injuries, as well as serious head injuries.

The following sections identify, by country, the number and severity of incidents between motorcyclists and safety fences:

3.4.1 Australia

Research by the Australian Transport Safety Bureau (2000) has summarised some of the known data for incidents between motorcyclists and safety fences in general:

- Accident studies consistently find that crashes involving any type of road safety barrier account for a small proportion (less than 5%) of rider casualties.
- A range of official mass accident data sources both in Australia and the United Kingdom give serious injury rate estimates of less than 1%.
- A detailed investigation of 222 casualty crashes in the Melbourne metropolitan area (Haworth et al, 1997) identified eight cases (3.6%) with some degree of barrier involvement.
- A study of all fatal motorcycle crashes in South Australia between 1985 and 1991 (Rogers and White, 1995) found that 2.6% involved initial collisions with 'guardrail'.
- Inspection of 1994 and 1996 Australian coroners' records identified nine motorcycle crashes – 2.4% of total rider fatalities – involving impact with a safety barrier.
- Collisions with fixed roadside objects make up nearly 40% of motorcycle fatalities in Australia and a similar proportion of car occupant casualties. The main roadside objects involved in fatal motorcycle crashes are trees, poles or signposts (70%).
- Around 63% of single vehicle motorcycle fatalities involve roadside poles, trees or some type of post. Increasing the number of posts by the side of the road (using the post-based wire rope system) will certainly increase this fatality rate.

In terms of the size of the problem in Australia, the state of Victoria's crash statistics indicated in a review of 2000 (Duncan et al, 2000) that between 1991 and 1995, there were 9059 accidents involving motorcyclists in Victoria, 84 of which involved the collision of the rider with a safety barrier. Australian Coroner's records indicate that 2.4% of the total number of rider fatalities involved collisions with safety barriers in 1994 and 1996.'

3.4.2 Austria

In Austria, 25 percent of motorcycle deaths are reported as being from impacts with safety barrier posts (motorcycle.com, 1998).

FEMA (2000) report statistics from Austria between 1990 and 1996 which show that whilst 5.2% of all motorcyclists' accidents occur with a safety barrier, they account for 11.7% of the fatalities, a disproportionately high number.

Figures from Östat (the Austrian Bureau for Statistics) also show that 40 % of accidents motorcycle accidents with a crash barrier end with severe injuries.

3.4.3 Canada

A review of accident statistics by Transport Canada in 1980 found that the probability of being killed as a result of impacting a safety barrier is more than double that for motorcycle crashes generally.

3.4.4 Denmark

In their publication of 2000, FEMA report that preliminary data from Denmark has also indicated that 10% of motorcyclists who leave the road hit a barrier. Of these, 20% of these receive fatal injuries from the barrier impact whilst 60% of them are seriously injured.

3.4.5 Finland

In 50 incidents with a safety barrier, 5 involved a motorcyclist (10%).

3.4.6 France

Work by Brailly (1998), studied French accidents involving a motorcyclist impacting a safety fence. The results showed that the risk of fatality per accident is five times as great as the national rate for all motorcycle accidents. The study was in two parts and comprised an analysis of national statistics recorded between 1993 and 1996 and a site analysis of 240 accidents that occurred on non-urban roads and involved at least one motorcyclist and an impact with a crash barrier. The study showed that a yearly average of 63 fatal, 114 serious and 118 slight cases resulted from impacts into a crash barrier. These account for 8% of all motorcycle fatalities and 13% of fatalities on rural (outside of towns) roads. More than 30% of the fatalities amongst motorcyclists killed by hitting an obstacle on roads outside of towns were caused by motorcycles impacting crash barriers.

3.4.7 Germany

Koch and Brendicke, (1988) conducted regional surveys in the Federal Republic of Germany between 1986 and 1987, and found that approximately 15% of motorcycle fatalities involved an impact with a safety barrier. The injuries reported were generally severe due to the aggressive nature of the guardrail design.

Uwe Ellmers (BAST, unknown) at the IfZ conference of 1998 presented the findings of a further study, reporting that the probability of receiving fatal injuries rises from 2.2% to 10.9% when the roadside is fitted with a safety barrier.

A report by Dohman (1987) also gives details of case studies where accident research investigating the number of motorcyclist injuries resulting from an impact with a barrier have been examined:

- Research in Tuebingen during 1984 shows that 16% of all motorcycle fatalities were linked to an impact with a safety barrier.
- Westfalen-Lippe 1980 to 1982: One in 6 motorcycle to safety barrier collisions resulted in a serious or fatal injury.

The report also investigated more general statistics regarding the German Highways and stated that among 50 motorcycle riders who struck a safety barrier, 3 were killed, 31 were seriously injured and 16 were slightly injured.

3.4.8 Norway

The Norwegian Public Roads Administration reports in its new guardrail standards, Handbook 231 (2003), that there are about 30 accidents reported annually where motorcyclists are injured in a collision with a guardrail. Among those injured in such accidents, approximately 3 (10%) motorcyclists are killed annually and 11 (37%) severely injured.

3.4.9 Sweden

A review of incidents on Swedish roads, compiled by Monash University (2000) has stated that 'motorcyclists are around 30 times more likely to be involved in a serious or fatal crash. However a further report by Monash University in 2003 continues by stating that 'in a further Swedish study of all motorcyclists killed between 1997 and 1998, 13% of the cases were involved an impact with a safety barrier.'

3.4.10 UK

The BMF (1995) have quoted a review of statistics for the year 1995, which indicated that motorcycle accidents accounted for only 4% of the impacts with safety fences but that these were only 0.07% of the total number of motorcycle accidents. Limiting the accident study to trunk roads reveals that approximately 3% of motorcycle injury accidents involved safety fences. The BMF believe, however, that the risk to motorcyclists has increased since these statistics were drawn up, because of the increase in motorcycle usage and installation of safety fence since 1995.

A full analysis of motorcyclist to safety fence accidents occurring between 1992 and 2005 is included in Section 6.

3.4.11 USA

A report by Elliott et al (2003) found that in 1984, approximately 3.5% of motorcycle fatalities involved safety fences.

Duncan et al (2000) report that impacts with safety fence posts in the USA cause injuries 5 times more severe than those from other motorcycle accidents.

3.5 Severity and Frequency of Incidents Involving Motorcyclists and Wire Rope Safety Fence

Research by the Australian Transport Safety Bureau (2000) has summarised some of the known data for incidents between motorcyclists and wire rope safety fences, although incident information is rarely collected in sufficient detail to identify the safety barrier type at the incident location:

3.5.1 Australia

An inspection of 1994 and 1996 Australian coroners' records, undertaken for this review, found no fatal motorcycle cases involving wire rope barriers (ATSB, 2000).

In Australia to the year 2000, the date of an ATSB report, there has been only one recorded motorcycle casualty and no fatalities involving wire rope barriers.

3.5.2 Denmark

A Danish study examined accidents involving different motorway median treatments during the period 1986 to 1993. At the time, a locally produced wire rope fence was the most commonly used type of motorway median barrier in Denmark. The study identified only three accidents involving motorcycles (no further details available).

3.5.3 Sweden

Only one known motorcyclist fatality has occurred involving a collision with a wire rope fence - the rider suffered a broken neck in the accident, though the source of the fatal injury was unclear.

3.5.4 UK

Section 7 of this report presents an assessment of impacts between motorcyclists and different types of safety fence, including wire rope safety fence, for those impacts occurring on English and Scottish roads.

3.5.5 Additional Wire Rope Safety Fence Incident data

Advice from LB Wire Ropes refers to only four known motorcycle impacts with Brifen fences. These comprised of two in the United Kingdom and one in Thailand, none resulting in injuries, and one in Australia, in which a rider survived a high speed impact with a barrier that was positioned on the outside of a curved embankment.

3.6 The Use and Implementation of Additional Motorcyclist Protection

The subsequent sections outline the methods being undertaken by a number of countries to address the issue of motorcyclist impacts with safety fences, and in some cases, the specific measures taken ton address wire rope safety fencing.

Any unreferenced information has been extracted from the responses to the questionnaire distributed as part of this project (see Section 2 and Appendix A).

3.6.1 Australia

The Government of Victoria have suspended the further use of wire rope safety fence pending further testing of the system (ATSB, 2000).

3.6.2 Austria

Guidelines for the provision of motorcyclist friendly devices are currently being prepared (the document will be named RVS 5.23) and these are expected to be published at the end of 2007/early 2008. These RVS documents often lead to transportation regulations and standards.

3.6.3 Belgium

Belgium is strongly opposed to the use of wire rope safety barrier (FEMA, 2005).

3.6.4 Denmark

The Danish Road Administration removed several thousand metres of existing wire rope because it was considered unsafe (FEMA, 2005).

3.6.5 Finland

There is currently a trial of two additional protection devices being undertaken within Finland to ascertain their durability and resistance to snow.

3.6.6 France

A report by FEMA (2005) stated that since the early 1980s, a device made of a metal plate fixed under the rail to prevent contact with the barrier posts has been designed and is used in France (sold by company SEC-Envel). Nearly 100 km of motorway have been equipped with such devices in the Paris region in 1997.

Due to the success of these initial installations, a programme for the implementation of motorcyclist-friendly safety barriers has been introduced (Avenoso and Beckmann, 2005).

The requirements state that:

(1) In designing new infrastructure, responsible authorities should make sure that new roads are built without dangerous street furniture and, when this is not possible, street furniture should be designed to be more forgiving. Mandatory road safety audits should remove roadside hazards within the design stages of a scheme.

(2) On existing infrastructure responsible authorities should eliminate unnecessary obstacles, move (where possible) obstacles away from the roadside or, in the last resort, isolate existing obstacles by means of an energy absorbing barrier. Mandatory road safety inspections should help identifying and removing existing roadside hazards.

In addition, directives given to regional road authorities by the French Minister of Transport summarise the priority areas to be equipped with motorcycle friendly devices:

- On motorways in curves with a radius less than 400m on the exterior.
- On normal roads, in curves with a radius less than 250m.
- On all roads, where there is banking in the road.

This applies to new installations.

As a result, a number of motorcyclist protection devices have been designed and tested in France.

All of those used have been homologated and are therefore approved for use.

3.6.7 Germany

Dohman reported in 1987 that protective devices such as post protectors and additional bottom rails had been installed on about 80 kilometres of safety fence in several German states.

However since this time, the Federal Ministry for Traffic (Bundesministerium für Verkehr, Bau- und Wohnungswesen) has developed the ‘Euskirchener Model’. This is a safety improvement project resulting from an integrated accident research and safety improvement project called ‘Safety Outside Built-Up areas’. The specific aim is to reduce fatal injuries to motorcyclists (FEMA, 2005).

The major step forward with this project is that it sought and received official testing and approval for the use of a secondary rail. It is to be used by all road authorities in Germany. Since type approval by the federal authorities, installation of the secondary rail is significantly on the rise in all federal states in Germany. The secondary rail is installed at a maximum of 5cm above the ground surface in order to prevent any body parts coming in contact with the posts. The secondary rail is not fitted to the posts, but is fitted with small brackets on the rail of the system. This rail does not touch the posts and thus, has an elastic reaction on impact.

The Euskirchen project has been carried out on the L165 from Münstereifel-Eicherscheid to Schuld (19 km), about 50 km south-west of Köln, in the Eifel region. All measures mentioned above have been implemented. More than 12,000 metres of the secondary rail have been installed in the district. The cost of fitting the secondary rail to the existing crash barrier is approximately €18 per metre.

In a paper by Ellmers (unknown) discussed three approaches are discussed regarding the provision of additional protection for motorcyclists:

- one involved a long-term program to replace sharp-edged “I” section posts (commonly used in Germany) with less hazardous “Σ” (sigma) posts
- another concerned that application of a second beam to the lower part of the guard rail: however, this was not viewed by BASt as a practical option because of cost factors and difficulties with curve installations (there were also uncertainties about how this modification would affect the overall performance of the barrier system)
- the most promising development was a plastic foam protector which could be easily fitted to each post; the main purpose of this device was to shield riders from the sharp edges of posts rather than to absorb the energy of the impact - tests suggested they would be most beneficial at low impact speeds (up to 20 km/h).

3.6.8 Italy

Motorcyclist friendly devices have recently been adopted by some local administrations as an experiment, for example Provincia di Bolzano, Provincia di Modena, Provincia di Perugia.

3.6.9 Luxembourg

In 1998 riders' rights organisation Lëtzebuerger Moto-Initiativ (LMI) started to fix Styrofoam protectors to the barriers, to show the Luxembourg government what to do. This was repeated in 1996. Following this pressure from the motorcyclists’ group it is now possible to install additional motorcyclist protection throughout the country.

As of 2005 a total of 10,000 metres of safety barrier had been made motorcycle-friendly. The cost of the attachment to existing barriers in Luxembourg lies between €22 and €25 per metre, depending on the quantity ordered. The project was carried out in co-operation with the national road authorities.

3.6.10 The Netherlands

The Minister of Transport has also stated that cable barriers will be banned from Dutch roads and all existing cable barriers have been removed.

The first secondary rail was fitted in 2003 and in total more than 3,000 metres of barrier have now been fitted with a secondary rail. The total cost for this project was €100,000. A decision was made by the Provincial Council of Utrecht that it would now only use the motorcycle-friendly barrier when new safety barriers are constructed.

So far one motorcycle-friendly crash barrier has been placed on the national road system. The Dutch national road authorities estimate the cost for a 'regular' crash barrier at €60 to €100 per metre (depending on the type of barrier). The additional cost for a motorcycle-friendly device fitted to the barrier is €25 per metre.

The Dutch Ministry of Transport has also made an inventory of their motorways to define those areas in which motorcyclist protection could be improved. The project will start with curves in accesses and exits.

3.6.11 Norway

On Friday 4th August 2006, after years of lobbying by the Norwegian Motorcycle Union (NMCU), the Norwegian Minister of Transport announced a ban on the use of cable barriers in Norway (NMCU, 2006).

Furthermore a report from the Norweigan Motorcycle Union (2006) states that '… even prominent members of the European Parliament (MEPs) have now suggested a ban in the European Union.'

In addition a test section of 100 metres of a plastic secondary rail has been installed, fitted to the existing steel beam barrier. The secondary rail is made of three, four or five plastic (polyethylene) tubes, connected together. This system is primarily designed to be installed as a secondary rail to corrugated steel beam barriers, using wooden posts. The project is in its initial phase, and further testing and evaluation remains to be done. The test project is carried out in cooperation with the Norwegian National Public Roads Administration. The exact price is not yet available, but is estimated be between €17 to €20 per metre (including installation).

3.6.12 Portugal

Portuguese Law 33/2004 requires all new safety barriers to have additional motorcyclist protection, and to retrospectively address old installations (starting with any black-spot areas).

According to the law 'The crash barrier protections shall be placed on the black spots of roads or shoulders whose location, characteristics, grade, or existing fixed and rigid obstacles less than two meters away from the limits of the carriage way, are likely to generate greater damages than those occurred in an impact against the said crash barriers, namely bridge abutments, piles, walls, poles and large trees.'

Further details are also given in the requirements for the placement of additional motorcyclist protection devices away from these black spot areas, with the highest number of the devices to be placed on bends where safety fencing is currently in place.

The use of an additional second rail is the main method of protection currently being utilised.

3.6.13 Spain

In Spain there is guidance for the provision of motorcyclist protection devices, but these are not mandatory.

3.6.14 Sweden

The National Road Administration in Sweden is concentrating exclusively on the installation of wire rope safety barriers. On the 1st January 2005 there were 950 km of Swedish roads incorporating wire rope safety barrier and every year another 150 -200 km are installed. The National Swedish Road Administration says that there are another 1,000 km that can be rebuilt with the wire rope barrier (FEMA, 2005).

Information from the Swedish Roads Administration has also stated that 'in a recent (2007) procurement process, motorcycle-friendly devices and safety barriers were allowed to be up to 25% more expensive than other systems when tendering.

3.6.15 Switzerland

The use of additional motorcyclist protection devices in Switzerland is the responsibility of the Local Authorities. Foam impact attenuators and/or additional protective rails are sometimes used on routes with a high density of motorcyclist traffic.

3.6.16 UK – A Case Study

In 2004, due to the identification of a motorcyclist accident black spot, a trial commenced on the installation of the motorcyclist protection device, a proprietary system called “BikeGuard” promoted in the UK by Highway Care.

The system is designed to cover the posts of the safety fence system, impacts with which are often thought to be the most severe type of impact with a safety fence (see Section 3.2.2). Although there are other designs of motorcycle friendly secondary rails, this type of secondary rail design is supported by the Motorcycle Action Group (MAG) UK and the British Motorcyclists’ Federation (BMF, 1995).

The BikeGuard system (FEMA 2005) has been tested to the EN1317 test requirements for cars whilst attached to a standard UK safety fence, and has been deemed, by the Highways Agency, to be suitable for installation on their roads. As a result, the product is listed on the Highways Agency’s list of approved products under ‘Miscellaneous items’ (Highways Agency, 2007).

The trial installation was located on the A2070 Cloverleaf Junction in Ashford, Kent (URL). The BikeGuard was used to supplement the existing barrier, a combination of tensioned corrugated beam (TCB) and open box beam (OBB) safety fence.

Prior to the installation of BikeGuard, 21 accidents, resulting in 25 casualties had occurred at the location – 3 of the casualties received fatal injuries, 8 serious and 14 slight injuries. Of those injuries sustained, 14 were attributable to motorcyclist accidents. In addition to the installation of the BikeGuard system, the speed limit of the road was also decreased to 50mph. Since the installation of the system, and the reduction in speed limit, there is circumstantial evidence that an impact has occurred with the safety barrier/BikeGuard system, however no personal injury occurred.

As a result, within the new Highways Agency requirements for the provision of safety barriers TD49/06 (Highways Agency 2006-A), it is stated that:

‘3.41 At sites identified, e.g. through accident records, to be high risk to powered two-wheel vehicles, such as tight external bends, consideration must be given to the form of VRS chosen to minimise the risk to this category of driver. Any special requirements must be stated in the contract.

3.42 At such high risk sites, it is recommended to use an ‘add on’ motorcycle protection system to post and rail type safety barriers to minimise the risk of injury to motorcyclists. The Design Organisation must check with the safety barrier manufacturer that any such proposed protection will not invalidate the tests on the safety barrier. Such ‘add on’ products must be approved by the Overseeing Organisation and be compatible with the safety barrier to which it is being attached as these products are not included within BS EN 1317.’

Partly as a result of these new requirements, and partly due to the positive results of the initial installation at the A2070 Cloverleaf Junction location, use of the BikeGuard has increased in recent years. As of September 2006, 5kms had been installed on Highways Agency roads, with 1.3km in place on the M27 J12 near Portsmouth, in Hampshire, and on the M4 J7 near Slough, in Berkshire (Highways Agency, 2006-B). In July 2007, an additional length of the BikeGuard system was also installed on the A537 in the Peak District National Park (Highway Care, 2007). On this road, whilst motorcyclists represent less than 2% of the road traffic, they account for 75% of fatal or seriously injured road users between 2004 and 2006.

3.6.17 Additional Measures

Whilst the success of the BikeGuard trial in the UK demonstrates the benefits of using additional protection for motorcyclists, a number of organisations and published literature sources have suggested a number of alternative solutions to improve overall road safety:

(From the Motorcycle Rider's Association of Western Australia (URL)):

- question the need for a roadside device in the first instance
- provide adequate clearance from carriageway to posts and poles (especially where motorcycles need to lean into curves)
- provide a clear zone
- minimise the number of posts and poles
- consider "soft" environmental elements between the road and roadside objects (e.g. hedges).

(From the Norwegian Public Roads Administration's 'Handbook for the Design and Operation of Roads and Traffic Systems' (Statens Vegvesen, 2004)):

- Avoid safety fence if this can be done with alternative measures
- Placing the safety fence further from the edge of the roadway

However when installing safety barriers, it has been suggested by organisations such as the BMF (2002) that other factors should be taken into account when selecting and installing safety barriers to specifically consider the safety of motorcyclists:

- In the choice and location of vehicle restraints
- In safety audits related to the use of vehicle restraints
- In the testing of vehicle restraints in accordance with the relevant standard
- By including testing of attenuators to protect motorcyclists from exposed posts in the standard
- By developing attenuators and motorcyclist friendly vehicle restraints

In addition, the Motorcycle Rider's Association of Western Australia (URL) have also identified the following points to consider in such circumstances:

- provide a clear zone
- minimise the number of posts and poles
- relocate poles away from the most exposed areas
- use semi-mountable kerbing instead of barrier kerbing on urban and rural roads
- use guide posts made of a material which doesn't break into sharp pieces'

In a similar way, a report into Swedish accidents by Monash University (2003) lists the following options;

1. A plastic fence to avoid both impact and trajectory, effectively reducing impact energy to survivable levels with either no impact or before impact into roadside objects such as guardrail.

2. Clearing the roadside and smoothening it with LECA marbles, (soft clay marbles), as on the tracks in the Grand Prix motor racing circuit. This solution handles trajectory quite well. The rider is decelerated gradually by a pile of clay marbles being ploughed in front of the vehicle/body. This requires a great distance to any roadside object to allow a significant decrease in speed with little or no impact

3. Adding padding to flexible barrier posts might improve the crashworthiness of the posts for motorcyclists in lower energy level crashes. There is an ongoing study for alternative guardrail for safer motorcycling through post-impact trajectory of motorcyclists in Malaysia, according to Ibitoye, A.B., Wong, S.V., Radin Umar, R.S., Hamouda, A.M.S. and Law, T.H., (2002)

4. Collaboration with the motorcycle manufacturers is crucial for achieving the best possible result in developing a more motorcyclist-friendly barrier. Already some manufacturers have created possible components that can be added on to the existing flexible barriers to address

issues particular to the motorcycle rider. The interaction between the rider, the vehicle and the road has to be developed rapidly.

Furthermore, the Norwegian Public Roads Administration's 'Handbook for the Design and Operation of Roads and Traffic Systems' (Statens Vegvesen, 2004) also lists the following range of solutions to address the problem:

- Eliminate the guardrail and replace it with other measures
- Replace post mounted guardrails with concrete barriers
- Fit sharp edged posts with plastic tube
- Install a lower rail when such solution is approved
- Making the top of the guardrail less dangerous
- Selecting safety fence without sharp or protruding details
- Using round posts

A review of motorcyclist safety and safety barriers in Australia by Duncan et al (2000) has also suggested the use of small shrubs and sand arrestor-beds either between the road and the barrier or in lieu of the barrier itself. However it was acknowledged that there are practical issues with such interventions.

4 Testing and Assessment

4.1 Testing Procedures

Within Europe the current full-scale impact test requirements for vehicle restraint systems are documented within the European standard, EN1317. More specifically, the test requirements for safety fences, barriers and parapets are contained within EN1317-1&2. For the testing of such devices, testing criteria is only designated for cars, buses/coaches and rigid/articulated HGVs. There are currently no requirements for the testing of vehicle restraint systems with motorcycles, nor motorcyclists.

However following a meeting of the European Technical Committee (TC) 226 in June 2007, work is due to commence in February 2008 to examine the issue of motorcyclist safety with regard to impacts with safety fences and barriers on a European basis. The final scope and mandate for this work is still under development, however it is envisaged that this will involve the harmonisation of current in-house testing techniques for motorcyclist protection devices.

At present two European test houses, CIDAUT in Spain (CIDAUT - UNE135900) and LIER (FEMA, 2000; LIER, unknown-A; LIER, unknown-B) in France have developed their own in-house testing specifications for the analysis of injury severity to motorcyclists impacting safety barriers. The CIDAUT requirements have now become a National standard within Spain, UNE 135900.

Both are similar in their fundamental approach, using a sled to accelerate a dummy towards a safety barrier system, releasing it from the sled just prior to impact. However there are a number of distinct differences between the two approaches, and these are tabulated below.

Table 1: Comparison of LIER and CIDAUT test procedures

Criterion	LIER	CIDAUT	
Test Set-up			
Dummy	Hybrid II dummy, fitted with the head and neck of a Hybrid III, 80kg	Hybrid III	
Impact Speed	60kph ± 5%	60kph	
Impact Angle	30 degs ± 0.5 degs	30 degs	
Dummy Orientation	On back, head forwards Test 1: at 30 deg to barrier Test 2: parallel to barrier	On back, head forwards All at 30deg to barrier	
Point of Impact	Test 1: Head aimed at post Test 2: Shoulder aimed at post	Test 1: Head aimed at post Test 2: Head offset from post Test 3: Head at centre-point between two posts	
Acceptance Criteria/Limits			
		Severity Level I	Severity Level II
HIC_{36}	≤ 1000	650	1000
Neck Force (Fx)	≤ 330daN	-	-
Neck Force (Fy)	≤ 330daN	-	-
Neck Force (Fz)	≤ 400daN	-	-
Neck Moment (Mx)	-	134Nm	134Nm
Neck Moment (My)	-	42Nm	57Nm
Neck Moment (Mz)	-	190Nm	190Nm

Both of the testing procedures assume that the dummy is dismounted from the motorcycle and sliding along the ground in a controlled manner during testing. No allowance is made for a rolling action in the dummy, nor has any testing been completed involving a dummy seated on a motorcycle during the impact event. This is due to the need for reproducible tests to be completed so that test results from different systems can be compared. The typical location of the rider (mounted or unmounted) during fatal incidents in England and Wales will be established during the examination of the fatal incident files within Section 7 of this report.

However it should be noted that for testing with four wheeled vehicles in EN1317, the test parameters used are not necessarily those seen most often within incidents, rather they are the 'worst case' which can be reproduced within a test laboratory. Many of these non motorcycle vehicles actually impact vehicle restraint systems whilst rotating and this cannot be reproduced in a repeatable manner by test houses – hence the controlled manner which EN1317 specifies. If a European standard for the testing of motorcyclist protection devices is to be developed, a decision must be made as to whether the testing should represent the 'worst case' or the more 'typical' impact scenarios. However defining a 'typical' scenario can be very problematic as different scenarios will depend on a number of contributory factors such as road type, radius of curvature and conditions, bike type, tyre condition, motorcyclist's experience etc.

4.2 Completed Testing programs

A number of testing programs have been carried out using dummies and vehicle restraint systems. These have shown that lowering the beam of a W-beam barrier will reduce the HIC value of an impacting motorcyclist to between 175 and 365 (Gibson and Benetatos, 2000). Note that a HIC value less than 1000 is preferred. However these are still higher than the HIC value of 110 received by a motorcyclist dummy when striking a concrete barrier.

In addition, testing has been completed by BASt in Germany impacting a motorcycle and rider dummy into a concrete New Jersey profile barrier, and two standard German profiles steel barriers, one with and one without a spacer between the rail and the post in an upright and in a side sliding configuration (Burkle and Berg, unknown; BASt, 2003). Two additional tests were also carried out on a steel fence with an additional rail fixed below that of a 'Swiss box-profile' system. From the testing it was established that the risk to riders is much lower when impacting against a modified system, no matter whether the vehicle is sliding, or in an upright position. Their research (BASt, 2004) concluded that motorcycle-friendly guardrails should provide the following features:

- Motorcyclist should slide along the rail without getting stuck (that means bigger openings should be avoided);
- Motorcyclist should be separated from the motorbike;
- Motorcyclist should not be redirected into the flowing traffic.
- Crash tests with motorcycle-friendly guardrails are not widely spread;
- Crash absorbers are used very often;
- Under-run protectors are used more and more;
- Motorcycle-friendly guardrails are seen as having a large safety potential.

One of the most common design of motorcyclist protection device currently being manufactured and promoted within Europe is that of a retro-fitting secondary rail, located underneath the main longitudinal of the safety fence system. Whilst this will improve the safety of the system for motorcyclists, the subsequent effect on passenger car safety was also assessed by BASt through full-scale impact testing. The testing indicated that there would be an increased probability of a car climbing up the barrier due to the addition of the lower secondary rail, although the results of the testing were still deemed to meet the requirements of the vehicle restraint testing standard, EN1317.

As of March 2004, the requirement for the provision of motorcyclist protection devices in Germany was as follows:

Table 2: Motorcyclist protection device requirements in Germany

Existing restraint system	Speed limit or driven speed average [km/h]	Is road section also a black spot regarding cars?	Recommended system
Guardrail ESP	> 70	Yes	Box beam guardrail with under-run protection
		No	ESP with under-run protection
	≤ 70		Crash absorber / ESP with under-run protection
Guardrail EDSP	> 70		EDSP with under-run protection
	≤ 70		Crash absorber / EDSP with under-run protection
Concrete barrier			Concrete barrier

In addition, BASt also stated the following general information regarding the use of motorcyclist protection devices:

- Post protection systems have a lower safety potential than retro-fitting secondary rails;
- Post protection systems should only be used on low speed roads;
- If financial resources are limited the usage of post protection systems is recommended even on high speed roads (low protection is better than none); another solution would be to lower the speed limit;
- The injury severity for motorcyclists is higher for restraint systems with IPE-posts.

4.3 Commercial designs

A summary of a number of motorcyclist protection devices which are commercially available within Europe at the present time is tabulated overleaf and within Appendix B. A number of these have been tested to the vehicle testing requirements of EN1317 and/or the motorcyclist protection protocols developed by LIER and CIDAUT.

This shows that whilst there are a large number of products currently available within Europe to reduce the severity of an impact between a motorcyclist and safety barrier, they are all designed to protect the motorcyclist from an impact with the post of the system. The majority of systems aim to achieve this by the addition of a secondary rail beneath the main longitudinal element(s) to spread any impacting load across a wider area, reducing the point loading effect of impacting a post. However some systems have been designed as ‘post protection systems’ which, whilst not spreading the impacting load, will assist in reducing the severity of an injury through protecting the motorcyclist from the sharp corners of the safety fence posts.

There is only one design of barrier which has been specifically designed with motorcyclist safety considered which has met the requirements of EN1317.

Of the system types listed overleaf, the literature review within Section 3 has shown that it is the secondary rail approach which is more likely to have a more positive effect in reducing the severity of injury to a motorcyclist during an impact as this approach will distribute the impact loads over a greater area if the motorcyclist is dismounted at the time of impact. A study of fatal incidents involving impacts between motorcyclists and safety barriers later on in this report (see Section 6) will look at the mechanisms resulting in injuries to motorcyclists during such impacts.

Name of Product	Manufacturer/Promoter	Type of system	Testing procedure	Result	Limit
BikeGuard	Highway Care, UK	Retro-fitting Secondary Rail	EN1317 (car)	Pass	
BikeGuard Euskirchen	SGGT, Germany	Retro-fitting Secondary Rail	Not reported		
CUSTOM	C.S.M S.p.A, Italy	EN1317 compliant with motorcyclist protection	EN1317 (car) LIER (dummy)	TB11: ASI = 0.9; THIV = 26kph; PHD = 10g TB32: ASI = 0.9; THIV = 24kph; PHD = 12g Test 1: HIC = 119; Comp. Force = 80daN; Trac. Force = 280daN; Shear Force = 150daN (all forces relate to neck) Test 2: HIC = 209; Comp. Force = 80daN; Trac. Force = 220daN; Shear Force = 260daN (all forces relate to neck)	ASI = 1.0 (Class A), 1.4 (B), 1.9 (C) HIC = 1000; Comp. Force = 400daN; Trac. Force = 330daN; Shear Force = 330daN (all forces relate to neck)
DR46	Snoline, Italy	Retro-fitting Secondary Rail	Not reported		
Ecran Motard	Sec Envel	Retro-fitting Secondary Rail	Dummy	HIC = 162 HIC = 233 (2X version)	HIC = 1000
Leitschienen-Vorhang	Dr Knut Spelitz	Rubber curtain	Tested, but procedure not reported		
Motorail	Solosar	Retro-fitting Secondary Rail	Not reported		
Motorail Euskirchen	Volkmann and Rossbach	Retro-fitting Secondary Rail	Not reported		
Motorail Feldberg	Volkmann and Rossbach	Retro-fitting Secondary Rail	Not reported		
Motoshield	Prins Dokkum	Retro-fitting Secondary Rail	CCT RW 99 (Construction requirements)		
Mototub	Sodirel	Retro-fitting Secondary Rail	Dummy	HIC = 296	HIC = 1000
RailPlast	Sodilor	Retro-fitting Secondary Rail	Not reported		
Motorcyclist Protection Device (SPM - ES4)	HIASA	Retro-fitting Secondary Rail	EN1317 (car) UNE 135 900	Pass HIC = 178 (impact with a post) HIC = 93 (impact between posts)	 HIC = 1000
SPIG Crash Absorber	SGGT, Germany	Post Protection System	Not reported		
SPU Crash Absorber	Volkmann and Rossbach	Post Protection System	Not reported		
Unterfahrschutz	Outimex, Germany	Retro-fitting Secondary Rail	Not reported		
Wire Rope Safety Fence Protection	Mr Johannson, Sweden	Wire rope cover	Not reported		
Post Protection Design	MAG	Post Protection System	Not reported		
Used Tyres	Portuguese Rider Groups	Use of used tyres around posts	Not reported		

Table 3: Summary of proprietary product testing to EN1317 and to motorcyclist protection testing protocol

5 STATS19 data analysis

Further details regarding the STATS 19 reporting mechanism and a summary of the collated and examined data can be found within Appendix C.

Graphical representations of the data can be located within Appendix D.

5.1 STATS 19 Search

In order to ascertain the probability of an incident involving a motorcyclist collision with a safety barrier, a search was made within the STATS19 database for any reported injury accident occurring:

- In England, Scotland or Wales;
- Between 1992 to 2005;
- On a major road (Motorway, A(M) and A roads);
- In which a motorcycle has struck a safety barrier in either the verge or the median.

This includes incidents in which other vehicles have been involved and hence the motorcyclist impact may not have been the only impact with the safety barrier.

Note that STATS19 records are produced for incidents occurring on all roads at which the police have attended, not just Highways Agency roads.

The output of such a search is a subset database which details each of the relevant impacts by the details contained within the STATS19 data collection form. These data were then further filtered and analysed to investigate the circumstances surrounding the incidents in general, and for specific incidents, and incident types.

5.2 STATS 19 Search Results

5.2.1 General Accident Overview

A total of 1,584,605 accidents, of all types (i.e. not only safety barrier impacts), occurred on major roads (Motorway, A(M) and A roads) between 1992 and 2005. These accidents involved 3,029,100 vehicles of which 75.7% were cars and 8.4% were motorcycles (see Figure D1).

The 1,584,605 accidents resulted in 2,233,288 individual casualties. Of these 31,590 (1.4%) received fatal injuries, 288,730 (12.9%) sustained serious injuries and 1,912,968 (85.7%) received slight injuries (see Figure D2).

As shown in Figure D3, data for the severity of injuries sustained by casualties in all impact types shows that motorcyclists are the most vulnerable type of road users, with 27.2% receiving fatal or serious injuries, compared to 12.8% for car occupants.

As shown in Figures D4 to D6, the majority of casualties result from accidents in which no object is struck. This applies irrespective of the vehicle type involved in the incident.

5.2.2 Safety Barrier impacts (all vehicle types)

Of the 2,233,288 casualties, 73,202 resulted from an impact between a vehicle and a safety barrier system. This represents 3.3% of all casualties on the major roads of Great Britain.

Just over half of the barrier impacts, 51.6%, occurred with a median barrier whilst the remaining 48.4% impacts occurred with a barrier located in the verge.

Of the 73,202 casualties resulting from impacts with a safety barrier (in the verge or in the median), 1,497 received fatal injuries (4.7% of all fatal casualties), 10,199 were seriously injured (3.5% of all seriously injured casualties), and 61,506 were slightly injured (3.2% of all slight casualties).

Hence, although casualties resulting from an impact with a safety barrier account for 3.3% of all casualties, they account for 4.7% of all fatal casualties and 3.5% of all seriously injured casualties. Hence impacts with safety barriers account for a disproportionately high number of fatal or serious casualties, irrespective of the vehicle type.

Median barrier impacts result in 1.9% of all car casualties, 0.6% of motorcyclist injuries, and 1.3% of casualties in other vehicles. In comparison, verge barrier impacts result in 1.7% of car occupant injuries, 0.7% of motorcyclist injuries, and 1.4% of injuries to the occupants of other vehicles. Hence the number of casualties resulting from impacts with safety barriers is relatively low.

Figures D7 to D10 indicate that whilst impacts with safety barriers are high severity impacts, other roadside features such as trees, telegraph/electricity poles and lamp posts are greater still in their severity, due to the point loading nature of any impact.

Figure D8 also demonstrates the vulnerability of motorcyclists. Impacts result in fatal or serious injuries in between 50 and 70% of all impacts in which a motorcyclist impacts an item of roadside furniture. This can be compared to a range of 10 and 20% of car occupants.

Of the 1,497 fatalities occurring as a result of an impact with a safety barrier (in the verge or in the median), 921 of the casualties were in cars (61.5%), 279 were on motorcycles (18.6%) and 297 were occupants in other vehicles (19.8%).

However 2005 road traffic data shows that 79.5% of traffic in Great Britain consists of cars, 1.1% of traffic consists of motorbikes and 19.4% of traffic consists of other vehicles. Hence, although motorcyclists contribute only 1.1% of traffic, they account for 18.6% of fatal safety barrier casualties.

5.2.3 Motorcyclist impacts with safety barriers

The severity of the impacts between motorcyclists and safety barriers can also be seen in **Figure D11**, where fatal or serious injuries result in approximately 65% of accidents. For car occupants, this value is much lower, approximately 15%, and approximately 20% for the occupants of other vehicle types.

However it should be noted that, as shown within Figure D11, the number of motorcycle to safety barrier incidents per year is relatively low. A total of 2,559 impacts occurred between a motorcycle and a safety barrier between 1992 and 2005 (183 per year), of which 19.9 per year resulted in fatal injuries (10.8%), 82.5 per year resulted in serious injuries (45.1%) and 80.4 per year are resulted in slight injuries (44.0%).

In terms of all motorcycle incidents on major roads, the severity of all motorcycle incidents is greater than for other types of vehicles (as seen previously), with 2.4% of casualties being reported as suffering fatal injuries, 24.8% serious injuries and 72.8% slight injuries.

Compare these to the general severity percentages for all incidents, 1.4% fatal, 12.9% serious and 85.7% slight and the relative severity of motorcycle incidents, and motorcyclist to safety barrier impacts in particular, can be seen.

However as stated previously, there are other roadside items which are more severe to motorcyclists and other road users than impacts with safety barriers (e.g. poles, posts and road signs).

The following Table compares the number of reported motorcyclist to safety barrier injury accidents by country and road length.

Table 4: Distribution of motorcyclist barrier accidents

	Scotland	England	Wales	TOTAL
Percentage of major roads in Great Britain	21	70	9	100
Percentage of all casualties in Great Britain	7	86	7	100
Motorcyclist to VRS casualties, 1992-2005:				
Fatal	29 (16.6%)	239 (10.9%)	11 (5.7%)	279 (10.9%)
Serious	83 (47.7%)	961 (43.8%)	111 (58.3%)	1155 (45.1%)
Slight	62 (35.6%)	994 (45.3%)	69 (36.0%)	1125 (44.0%)
Total	174 (100%)	2,194 (100%)	191 (100%)	2559 (100%)
Motorcyclist to VRS casualties per year:				
Fatal	2.1	17.1	0.8	19.9
Serious	5.9	68.6	7.9	82.5
Slight	4.4	71.0	4.9	80.4
Total	**12.4**	**156.7**	**13.6**	**182.8**

These data show, once again, that the number of incidents between motorcyclists and safety barriers is low in number, although they can result in high levels of injury severity. These data also show that, given the relative lengths of road in Scotland, England and Wales, Scottish roads have a lower rate of such incidents than the other constituents of Great Britain.

Figure D12 shows how the number of motorcyclist to safety barrier impacts has risen over the past fourteen years within Great Britain. Growth can be seen in all three of the incident severity classes, and the total growth can be seen to be at a greater rate than the growth in the number of motorcycles on major roads. Hence, whilst the number of motorcyclist to safety barrier incidents is relatively low at present, the trend is for a general increase.

Figure D13 shows that in Scotland whilst the number of casualties resulting from motorcycle to safety barrier impacts is low (averaging 12 casualties per year), the overall trend is similar to that seen on the National level, i.e. an overall increase in the number of incidents.

5.2.4 Detailed examination of motorcyclist to safety barrier incidents

A detailed examination of the STATS19 data for impacts between motorcycles and safety barriers indicates that 46% of the impacts occurred with a median barrier.

Figures D14 to D16 show that the majority of the median barrier impacts, 66.1%, were on roads limited to 70mph, although this is not surprising as median barriers are generally installed on high speed, dual carriageway roads – hence the probability of such an impact is increased. Roads with a speed limit of 70mph also witnessed 33.6% of the motorcycle accidents with verge barriers, with 36.2% of such barrier incidents occurring on 60mph roads.

Figures D17 to D19 show that a total of 76.1% of the motorcyclist to safety barrier accidents occurred on an A road, with only 22.1% occurring on motorways. However, in the UK motorways make up only 7% of the trunk road network, compared to 93% of A roads. As a result, the number of accidents occurring on motorways is disproportionately high, however this may be for a number of reasons such as the road speed and/or the relative quantity of barriers installed.

Figures D20 to D22 show that in general it is unlikely that any other object is struck in the carriageway before striking a safety barrier, however kerbs were struck before a safety barrier in 16.2% of the reported incidents. The influence of such an impact on the outcome of an incident is unknown, however the relative severity of any injuries sustained by hitting a kerb is no greater than if the motorcyclist hit nothing before the safety barrier.

In total, 79.5% of the motorcyclist accidents with safety barriers occurred during daylight hours as shown in Figures D23 to D25. This may be partially due to the greater number of motorcyclists on the roads at this time of the day. Only 8.4% of incidents occurred during darkness (i.e. at night and unlit). Hence poor forward visibility is unlikely to be a contributory factor to motorcyclist to safety barrier incidents. This is substantiated by the 89.2% of accidents which occurred during fine weather without high winds, whilst 82.1% occurred on a dry road (see Figures D26 to D31). This increase in the number of accidents during pleasant riding conditions may be due to a resulting increase in the number of riders during fine weather (for leisure purposes), however no data can be obtained to substantiate this hypothesis.

An examination of the sex of the motorcyclist injured by an impact with a safety barrier (see Figures D32 to D34) shows that 92% of the injured motorcyclists were male, even though male riders only travel 75% of the motorcycled miles (Department for Transport, URL). Hence the number of male riders injured is disproportionately high. Male riders are also more likely than female riders to be either killed or seriously injured during an impact with a safety barrier.

An examination of the age of the casualties from such incidents shows that the greatest age range at risk is in the category between 20 to 39 years of age, with the highest proportion of killed or seriously injured falling into the age range 20-29 (see Figures D35 to D37).

Department for Transport data show that the age of motorcyclists with riders licences is comprised of the following groups:

Table 5: Motorcyclist age distribution

Age Range	Percentage of motorcyclists	Percentage of Killed or Seriously injured
<20	8	6.7
20-29	15	36.8
30-39	28	34.2
40-49	23	14.2
50-59	17	5.8
60+	9	1.4

Hence the percentage of motorcyclists killed or seriously injured aged between 20-29 and 30-39 are disproportionately high.

5.2.5 Analysis of FATAL motorcyclist to safety barrier impacts

Whilst a full review of the fatal motorcycle to safety barrier impacts are contained within Section 9 of this report, an examination of the STATS19 data relating to the fatal incidents gives an overall impression of the characteristics of such impacts. These factors can also be used comparatively with those detailed in the previous section.

A total of 279 fatal incidents occurred between a safety barrier and a motorcyclist between 1992 and 2005. Of these;

- 17% of the fatal motorcycle to VRS impacts involved a prior impact with a kerb. 77.6% involved no pre-collision.
- 72.7% of the fatal incidents occurred during daylight, whilst 84.6% were in lit surroundings (e.g. daylight or a lit road);
- The majority of the accidents occurred between 11am and 1am with a peak between 3pm and 4pm (10%) and between 5pm and 6pm (9%). This may be expected due to rush hour traffic and the number of motorcyclists on the roads at that time (see Figure D41)
- 93.5% of the fatal incidents occurred during fine weather with 85.8% of the fatal incidents occurred on a dry surface, 13% occurring on a wet/damp road;
- 70 of the 279 (24%) occurred on motorways, the other 209 occurring on A(M) and A roads;
- 36.5% of the fatal casualties were aged between 16 and 29. This age category travel 49% of the miles travelled by motorbike, but only account for 20% of riders [Department for Transport, URL];
- 60.0% of the fatal casualties were aged between 30 and 59. This age category travel 44% of the miles travelled by motorbike, but account for 69% of riders [Department for Transport, URL];
- 0.7% of the fatal casualties were aged over 60. This age category travel 7% of the miles travelled by motorbike, but account for 10% of riders [Department for Transport, URL].

6 Fatal File Analysis

Further details regarding the TRL fatal file collection, reporting mechanism and a summary of the collated and graphical representations of the data can be located within Appendix E.

6.1 Results

A total of 110 of the 278 police files relating to fatal incidents were available within TRL's collection. The relevant information from each file was then extracted and analysed:

- Engine size;
- Year of registration;
- Type of safety fence impacted;
- First element of the fence contacted;
- Cause of death of the fatality;
- Protective clothing worn;
- Whether the rider was on the bike at the time of impact;
- Pre-impact movement of the rider (and bike);
- Other relevant comments.

The remaining 169 cases were unobtainable as they were either Scottish cases which, as previously explained, are not covered due to differences in legal systems, or cases from regions which do not supply files to TRL.

6.1.1 Age of motorcycle involved in the fatal safety fence incidents

From Figure E1 it can be seen that the age of the motorcycle involved in the fatal safety barrier incidents at the time of the incident range from less than 1 year to 17 years old. The age of the motorcycle involved in the incident decreased steadily from a peak at one year of age. There was also a secondary peak at five years of age. From these data it can be deduced that younger bikes were involved in more fatal safety barrier incidents than those of a greater age.

6.1.2 Engine size of motorcycles involved in safety fence incidents

The engine size of the motorcycles ranged from 90 to 1300cc with 28% equal to or above 1000cc (Figure E2). 18% of the motorcycles had a 600 to 699cc engine whilst 16% were 125 to 499cc in size. The average engine size for the motorcycles involved in the fatal incidents was 725cc.

6.1.3 Type of safety barrier struck

The incidents were examined by the type of barrier struck during the incident. Figure E3 shows that the most frequently impacted safety fence type was the Single Sided Tensioned Corrugated Beam (SSTCB), in 31% of cases.

This was followed by the Single Sided Open Box Beam (SSOBB) in 24% of incidents.

The double sided versions of these barriers were the next most frequently struck, with just 3% of the incidents involving wire rope safety fences.

There were a high proportion of fence types reported as 'Other' and 'Unknown' fences (10% and 13% respectively). 'Other' was classified as anything which was struck that was not deemed to be a safety barrier (e.g. a brick planter, bridge support, lamp post, bus). 'Unknown' was used in cases where a safety barrier was known to have been impacted, but the exact type of barrier was unclear from the details within the police file.

There were no incidents for which an impact with a concrete barrier was reported.

The respective percentages for the different types of safety fence impacted during an incident are likely to be as a result of the lengths of the different barrier types installed on the Network. As at the 3rd of August 2007, these were as follows (for comparison):

Table 6: Percentage of barrier impacted by motorcyclists, by installed length

Type of safety barrier	Length of barrier on Highways Agency Network, in km *1 (as at 3rd August 2007)	Percentage of total length on barrier installed	Percentage of motorcyclists impacting the barrier, resulting in fatal injuries
Single sided TCB	3803	36.6	31.2
Single sided OBB	2755	26.5	23.9
Double sided TCB	2684	25.8	7.3
Double Sided OBB	231	2.2	6.4
Wire rope safety fence	131	1.3	2.8
Concrete barrier	88	0.8	1.8
Other	709	6.8	26.6 *2
TOTAL	10401	100	100

*1 Source: Highways Agency Pavement Management System

*2 Note: This includes those fatal police reports for which the type of safety barrier was not reported, or insufficient detail was given to ascertain the barrier type.

Single sided TCB is the most commonly installed type of safety fence and hence, it is not surprising that this accounts for the highest number of impacts.

Wire rope safety fence accounts for 1.3% of installations on the Highways Agency Network, and accounted for 2.8% of the fatalities reported within the fatal file analysis (although the number of actual fatal incidents was low). Due to the low number of incidents, no statement can be made as to whether the number of fatal injuries resulting from an impact with a wire rope safety fence is disproportionately high or not.

However, it can be stated that the number of fatal injuries resulting from impacts with double sided TCB do appear to be disproportionately low – although the reason for this is unknown. It is hypothesised that this may be due to a large amount of such barrier being installed in the median of motorways where the number of incidents between motorcyclists and barriers is low. With the system being of the double sided variety, this (as for double sided OBB) will generally only be installed in the median of roads where the width of the central median is limited.

6.1.4 Motorcyclist's point of first contact with the barrier

On impact with a barrier, the motorcyclist struck the post first in 32% of the incidents. A rail was first struck in 40% of the incidents, as shown in Figure E4.

Half of the motorcyclists who struck a SSTCB safety fence struck the rail first, with 35% striking the post (see Figure E5).

For Double Sided TCB (DSTCB) safety fence impacts, a post or a rail was the first part of the barrier struck in 37% of the incidents (see Figure E6).

In impacts with SSOBB, the rail was the first element struck in 58% of cases, with 19% hitting a post (see Figure E7).

Double Sided OBB (DSOBB) had its post struck first in 71% of the fatal incidents, with 29% colliding with a rail (see Figure E8).

There were three reported incidents involving a motorcyclist impacting a wire rope safety fence within the dataset of 110 incidents. In each case the post of the system was struck first (see Figure E9).

6.1.5 Location of motorcyclist at the moment of impact with the barrier

An examination of the police files has shown that 58 (53%) of the riders were still mounted on their motorcycle at the time of impact with the safety barrier, 33 (30%) were dismounted, and the location of the other motorcyclists is unknown.

For impacts in which the motorcyclist was mounted on the motorcycle at the time of impact, the majority (49%) of first struck the longitudinal rail. A further 19% struck the safety fence posts and 10% a combination of the post and the rail (see Figure E10).

When the motorcyclist was dismounted from the motorcycle before impacting the safety barrier, 58% first struck a post, with 21% striking the rail (see Figure E11).

6.1.6 Pre-impact motion of the motorcycle (or the rider and motorcycle)

From Figure E12 it can be seen that when a motorcyclist struck a post first during an impact with a safety fence, they were most likely to have been sliding across the carriageway before the impact (65%). In order for the point of first contact to be with the safety fence beam, they were more likely to have still been mounted riding the motorcycle (62%). This is not surprising given the relative heights of a safety fence beam and a sliding or mounted motorcyclist.

Pre impact movements of rolling or sliding resulted in impacts with the safety fence posts (in 67% and 59% of cases respectively).

When riding or ‘flying’ i.e. not in contact with the ground, the most likely impact was with the safety fence beam (59% and 50% respectively). These data are shown graphically in Figure E13.

Of those impacts where the pre impact motion of the motorcyclist has been reported, 47% of impacts were due to the motorcyclist riding the motorcycle, 37% of the riders were sliding, 4% were rolling, and 12% were flying (i.e. not in contact with the ground).

6.1.7 Location of motorcyclists’ injuries

‘Multiple Injuries’ were reported as the most common cause of death on the post mortems associated with motorcyclist impacts with safety fences. Multiple injuries are often recorded alongside the note of “The injuries are consistent with those sustained in a road traffic accident”. When an analysis of the injuries reported as multiple was carried out, 90% of suffered severe trauma to the head. Most also suffered injuries to the thorax, usually involving fractured ribs and associated internal organ injuries.

When a motorcyclist’s first point of contact with a safety fence was with a post (see Figure E14), the cause of death was most frequently recorded as multiple injuries (38%). This was followed by injuries to the head (26%).

In 64% of cases, the motorcyclist struck the beam first and suffered multiple injuries (see Figure E15).

Head injuries were the most common (29%) reported injury mechanism for impacts with a combination of the post and rail of the safety fence system (Figure E16).

Unknown causes of death are due to the absence of a post mortem report in the police fatal files and/or the lack of any comments on cause of death in the police reports.

6.1.8 Protective clothing worn by the fatal casualties during the impact

As shown in Figure E17, 90% of those fatality injured during an impact with a safety fence wore a helmet. In 51% of these cases the helmet stayed on during the impact. In those cases where the helmets came off during the impact, they were either not fastened sufficiently, the fatality was struck from the chin forcing the helmet off, or the motorcyclist suffered decapitation (in which case the force of the impact was such as to remove the helmet). However in many cases, the exact reason for the removal of the motorcyclist's helmet is unknown. Helmets are the most frequently recorded piece of clothing in police reports and therefore this category had the least number of unknowns.

Motorcycle jackets were known to have been worn by 48% of the fatalities and motorcyclist trousers were worn by 36% of the fatalities. Protective trousers were not worn in 17% of the incidents.

Gloves were worn by 33% of the fatalities. One of these fatalities was recorded as wearing only one glove, with the un-gloved hand holding a clip-on tie during the incident. His jacket was also open thus indicating that he was getting dressed as he was riding.

Motorcycling boots were worn by 29% of the fatalities.

Elbow/kneepads are very rarely recorded by the police forces in the fatal incident files as they are often integral to the jackets/trousers.

6.1.9 Analysis of helmet use with respect to head injuries

As stated earlier, helmets were worn in 90% of cases, 3% definitely did not wear a helmet and the remainder had unknown helmet use. It was found that, of the 28 cases with cause of death recorded as the head only, all fatalities were wearing a helmet.

When a post was struck, in 56% of these accidents, the helmet stayed on throughout the incident, with 44% coming off. Half of the helmets stayed on when the first point of impact was with the rail (see Figure E18).

However it should be noted that the number of incidents in the rail and post/rail groups, is small and therefore no definite conclusions can be drawn.

6.1.10 Analysis of motorcycle jacket use with respect to thorax and abdomen injuries

For the seven cases where the cause of death was recorded as thorax or abdomen, two were wearing jackets. One of these fatalities hit a post and the other did not strike a safety fence, but a 2ft high metal boundary railing around the grounds of an office building (recorded as 'Other').

No cause of death injuries that were directly related to leg or arm injuries and hence, an analysis of this body region was not carried out.

6.1.11 Multiple injury incidents broken down by element struck

Fatal injuries reported as being of the 'multiple' type occurred as a result of an impact with the safety fence beam in 57% of cases. Post impacts were described as multiple in 28% of the impacts (see Figure E19).

When the first point of contact was the safety fence beam, the motorcyclists were often thrown into the air into the barrier or into the path of oncoming vehicles (see Figure E20). This then resulted in further injuries. When the first point of contact was a post, the fatalities tended to have remained at that post or continued to slide or roll along the ground and strike other posts with similar body regions.

6.1.12 Road geometry at the fatal accident sites

Unlike the fatal police file analysis (for which accident information were available for 110 of the 278 fatal incidents on Great Britain), an examination of the geometry at all of the fatal incident sites was made for all 278 fatal incident locations.

The co-ordinates of each incident were extracted from the STATS19 database, together with the direction of travel of the motorcyclist prior to the time of the incident. Information from STATS19 as to whether the vehicle was going ahead around a left hand bend, right hand bend, or continuing straight on was also collated.

Each of these locations was then plotted on a map of Great Britain, and the location of the incident was validated. In some cases the entry into the STATS19 database was incorrect (e.g. the motorcyclist was reported as continuing straight on when in fact it was negotiating a bend), and hence these were corrected before the commencement of the analysis.

Of the 278 fatal accidents, 158 (56.8%) involved an impact between a motorcyclist and a median barrier, 120 (43.1%) impacting a barrier in the verge.

A barrier was struck on a straight length of road in 107 (38.5%) cases (i.e. a road of radius greater than 1km), whilst 89 (32.0%) occurred on a left hand bend and 53 (19.1%) occurred on a right hand bend.

In addition, 17 incidents (6.1%) occurred on slip roads, and 9 (3.2%) occurred at a roundabout. In three cases, details of the location of the incident were unknown or incorrectly reported such that they could not be corrected.

Of the 158 incidents involving an impact with a median safety fence, 74 (46.8%) occurred on a straight length of barrier, 59 (37%) occurred on a left hand bend, and 16 (10.1%) occurred on a right hand bend. A further 6 (3.8%) occurred on a slip road, 2 (1.3%) at a roundabout, and for one incident the location details were incorrectly reported (see Figure E21).

Impacts against median barriers occurred mostly where the radius of the bend was large (1km and above) (see Figures D22 and D23). This is not surprising as median barriers are more likely to be installed on motorways and faster A roads which are often straight in their layout. Hence the opportunity for a motorcyclist to impact a median barrier on a tighter radius curve is reduced. However the number of incidents occurring on a slip road is quite high given that the probability of such an impact occurring is low due to the relative lengths of barrier in such locations.

Of the 120 incidents involving an impact with a verge safety fence, 33 (27.5%) occurred on a straight length of barrier, 30 (25.0%) occurred on a left hand bend, and 37 (30.8%) occurred on a right hand bend. A further 11 (9.2%) occurred on a slip road, 7 (5.8%) at a roundabout, and for two incidents the location details were incorrectly reported (see Figure E24).

Impacts against barriers in the verge occurred mostly where the radius of the bend was small (200m or less), particularly on right hand bends (see Figures D25 and D26). However the number of incidents occurring on slip roads and at roundabouts is quite high given the probability of such an impact occurring is low due to the relative lengths of barrier in such locations.

The larger number of median impacts on left hand bends with a large radius and verge impacts on right hand bends with a small radius may indicate that excessive speed may have been partly contributory in the incidents due to the mechanics of the incidents.

6.2 Case Studies of Wire Rope Safety Fence (WRSF) accidents

As there were three reported fatalities involving an impact between a wire rope safety fence and a motorcyclist (for which TRL have the associated police report) case studies for these incidents are documented in the following section.

6.2.1 Case example 1: TRL case 11093

6.2.1.1 Accident scene layout

The accident occurred on a dual carriageway bridge as it passed over a river. The road was straight, with a central reservation separating the two carriageways. To the offside of the main carriageway was a footpath, protected by a wire rope safety barrier, i.e. the impacted wire rope safety barrier was located in the verge.

A plan of the scene is shown in Figure E27.

6.2.1.2 Accident description

At the time of the accident the weather was very poor, with drizzle turning into heavy rain, accompanied by poor visibility and high winds. Shortly after overtaking a car on the bridge, while positioned in the centre of the carriageway and travelling above the speed limit, the rider lost control of the motorcycle, possibly due to a sudden gust of wind. This appeared to have been exacerbated by the excessive use of a "rubberised bituminous material" used to fill gaps in the tarmac road surface. These areas had become extremely slippery due to the wet conditions, and caused the motorcyclist to loose control. There was also evidence of an unidentified oily substance on the tyres of the bike, which would have reduced grip further.

The motorcycle dropped to its side and slid along the carriageway until it collided with a post of the four rope wire rope safety fence. Nine metres further along the fence, there was evidence of an impact between the rider's crash helmet and another of the fence posts as a result of the motorcyclist sliding along the carriageway. The motorcyclist sustained multiple injuries. A post mortem was not available, so the exact injuries sustained are not known.

6.2.1.3 Protective equipment worn by the motorcyclist

The motorcyclist was wearing a helmet at the time of the accident, and this helmet was still in place after the rider had come to rest. The motorcyclist was not wearing boots, and it is not known what other protective equipment was being worn at the time of the accident.

6.2.2 Case example 2: TRL case 21087

6.2.2.1 Accident scene layout

A plan of the scene is shown in Figure E28.

6.2.2.2 Accident description

A motorcycle and a car were both travelling westbound on a dual carriageway. The motorcycle struck a glancing blow against the offside of the car, with both the motorcycle and the rider being in contact with the offside of the car.

The motorcycle then struck and crossed the wire rope safety fence in the median of the dual carriageway, coming to rest in the deceleration lane of a junction on the eastbound side of the dual carriageway. The body of the rider was found on the westbound side of the carriageway.

One of the posts of the wire rope safety fence showed contact damage, but the exact interaction with the rider or motorcycle is not known. The rider suffered multiple injuries, although a post mortem was not available.

6.2.2.3 Protective equipment worn by the motorcyclist

At the time of the accident the motorcyclist did not appear to be wearing a helmet. A visor was found at the scene, but no helmet was located, despite an intensive search. However it was reported that the motorcyclist was wearing a motorcycle jacket, trousers and boots.

6.2.3 Case example 3: TRL case 26099

6.2.3.1 Accident scene layout

The accident took place on a motorway, at a point where the road begins to descend and curve gradually to the left. This length of road is unlit and the accident occurred in darkness.

No layout diagram of the scene is available for this accident.

6.2.3.2 Accident description

A car pulling a trailer was travelling in the nearside lane of a motorway, when the nearside tyre deflated, causing the vehicle to loose control. It crossed the carriageway and came to rest jammed against the barrier in the central reserve, facing in the opposite direction to travel.

A following car took avoiding action around the vehicle and debris from its trailer, but lost control, striking the nearside barrier protecting a bridge parapet and coming to rest in the centre lane. A third vehicle, a box truck, braked and activated hazard warning lights then stopped in the centre lane.

Following the box truck was a 1000cc motorcycle. This attempted to steer to the offside lane to avoid the rear of the box truck, but the motorcycle toppled onto its offside and slid into the central reserve. Both bike and rider collided with the wire rope safety fence in the central reservation. The rider came to rest in the central reservation, but the bike rebounded into the offside carriageway, where it was hit by a car and propelled across the carriageway, coming to rest on the hard shoulder.

The rider’s crash helmet had impacted one of the posts supporting the wire rope safety fence, and this blow was the principle cause of death.

6.2.3.3 Protective equipment worn by the motorcyclist

The rider was wearing a protective helmet, jacket, trousers, gloves, knee pads and boots. The helmet remained on during the accident.

7 The Severity of Incidents involving Wire Rope Safety Fence

In addition to an examination of fatal incidents between motorcyclists and safety fence systems, a parallel exercise was also carried out to identify the severity of incidents occurring between motorcyclists and wire rope safety fences compared to impacts with other safety barrier types.

The need for this further examination arose due to accident statistics collated by Transport Scotland. These data revealed that between 1990 and 2005 (inclusive) there were 31 reported incidents in which a motorcyclist struck a median safety barrier on Transport Scotland roads. Of these 7 involved an impact with a wire rope safety barrier system, whilst the remaining 24 involved an impact with a different type of fence (not declared).

From the 31 median barrier incidents, the following severity of injuries has resulted:

Type of Barrier	**Fatal**	**Serious**	**Slight**	**Total**	**KSI (%age)**
Wire Rope	3	4	0	**7**	**100**
Other	5	9	10	**24**	**58.3**
Total	**8**	**13**	**10**	**31**	

Table 7: Severity of Median Barrier impacts on Transport Scotland roads, 1990 to 2005, by barrier type

These data clearly show an increased risk from motorcyclists impacting a wire rope safety fence than for other safety fence types, however these data should be used with some caution as there may be other factors which would influence the severity of the resulting injuries which have not been considered such as the protection worn by the motorcyclist, road layout, visibility, and impact speed and angle.

This is also a relatively small dataset (approximately 2 casualties per year). As a result, a similar exercise was completed for incidents occurring on Highways Agency roads in England. This used the STATS19 incident data and the wire rope safety fence locations documented within the Highways Agency's Pavement Management System (HAPMS) to identify those impacts between a motorcyclist and wire rope safety fence. Care was taken to ensure that the correct carriageway and direction of travel were being considered to account for non symmetrical safety fence provision.

Hence the data showed that between 1992 and 2005 there were 1814 reported incidents in which a motorcyclist struck a safety barrier on a Highways Agency road. Of these 9 involved an impact with a wire rope safety barrier system, whilst the remaining 1805 involved an impact with a different type of fence (not identified).

From the 1814 barrier incidents, the following severity of injuries has resulted:

Type of Barrier	**Fatal**	**Serious**	**Slight**	**Total**	**KSI (%age)**
Wire Rope	1	5	3	**9**	**66.7**
Other	214	847	744	**1805**	**58.7**
Total	**215**	**852**	**747**	**1814**	

Table 8: Severity of Median and Verge Barrier impacts on a Highways Agency road, 1992 to 2005, by barrier type

Whilst the number of motorcyclist to wire rope safety fencing impacts appears small (approximately 0.5%), it should be recalled that wire rope safety fencing constitutes only 1.3% of the total length of barrier installed on the Highways Agency's Network. This particular barrier type is also, generally installed in medians with a straight configuration and, as has been seen from the assessment of the police files relating the fatal incidents, only 38.5% of all motorcyclist to safety barrier impacts occur on straight road sections.

Hence Tables 8 and 9 show that whilst the number of motorcyclist to safety barrier impacts are low in number, and the subset of impacts with wire rope safety fencing much lower still, there does appear to be an increased risk to motorcyclists when impacting wire rope safety fencing than some other types of safety fencing, particularly in Scotland. However once again, other factors which would influence the severity of the resulting injuries which have not been considered such as the protection worn by the motorcyclist, road layout, visibility, and impact speed and angle.

The data also show that for impacts with 'other' types of safety barrier, the severity of impacts is similar between roads in Scotland and those in England.

In addition to the HAPMS/STATS19 methodology outlined above, the Highways Agency's maintaining agents were also contacted to determine the type of safety present at the motorcyclist to safety fence incident locations in 2005. Of these, responses were returned for 96 of the 125 incidents. These confirmed the entries within the HAPMS records system and hence, ensured confidence in the HAPMS data examined.

8 Conclusions

8.1 Literature Review *(Sections 2, 3 and 4)*

- There have been a relative large number of documents produced within Europe and Australia examining the interaction between safety fences and motorcyclists.
- Much of this early work concentrated on the impacts between the specific case of wire rope safety fencing and motorcyclists.
- A review of motorcyclists' driving habits in Sweden has shown that the location of wire rope safety fence does not effect the choice of route taken by motorcyclists, but it can alter the speed and riding location of the carriageway.
- Many of the reviews of accident data from within Europe, has shown that the number of incidents occurring between motorcyclists and safety fencing is relatively low; however such impacts often result in high severity injuries.
- However it has now been concluded, based on accident research, that the largest number of injuries result from impacts with the posts of safety fences, rather than the beams (be they wire rope, corrugated beam, or of a box profile).
- As a result, there is no evidence to support the claim that a motorcyclist impact with a wire rope safety fence is any more injurious than an impact with any other type of post and rail safety fence system.
- However some Europen countries have stopped the use and, in some cases removed, lengths of the system.
- A review of accidents within Europe has shown that impacts with trees and sign poles are generally more hazardous to motorcyclists than those with safety fencing.
- Smooth faced barriers (including concrete barrier) are preferred by motorcyclists.
- A review of accidents has shown that the majority of incidents occur with the motorcyclist still mounted on their motorcycle and hence the top of the posts can be as hazardous as the lower (i.e. below rail) section.
- In order to reduce the severity of impact between a motorcyclist and a safety fence post, two main types of post protection system have been developed by European manufacturers; an individual post protector fitted around the safety fence post, and a secondary rail attached beneath the main longitudinal rail of the system. Both have the aim of reducing the severity of an impact with the fence.
- Many of these systems have been tested to one of two currently used testing procedures, one developed within France, and a second, now a National standard, in Spain.
- One of the European Commission's Technical Committees has recently announced that it will be preparing a mandate to establish a group to examine motorcyclists' safety with respect to the design and installation of safety barriers.
- Both of the current test procedures use a dummy on a sled to represent a motorcyclist sliding across a carriageway before impacting the safety barrier.
- No test procedure currently exists to examine the effect of a motorcyclist impacting with a safety fence whilst still mounted on the motorcycle at the time of impact, even though this appears to be the most common impact scenario.
- All tests completed to date on motorcyclist friendly designs have resulted in dummy readings much lower than the prescribed pass/fail criteria.

- Motorcycle-friendly devices are currently being installed in thirteen of the eighteen countries responding to a questionnaire (these being Austria, Belgium, England, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain and Switzerland).
- Of these, only five have National regulations documenting their requirements for the use of such systems, these being Belgium, England, France, Germany and Portugal.
- Five of the responding countries namely, the Czech Republic, Denmark, Greece, Ireland and Sweden, do not currently implement such systems.
- Within Europe, the requirement to install motorcyclist protection devices is increasing, with a number of countries incorporating requirements into National standards and guidelines.
- In general, the use of motorcyclist protection devices is not recommended at all locations due to the resulting cost/benefits, however their use in some specific areas would be beneficial – however these locations depend on a number of factors such as road type, geometry and speed limit.
- Impact tests have shown that the use of a secondary rail, installed underneath the main longitudinal of a safety fence can increase the likelihood of a car pitching upwards during an impact.

8.2 STATS19 Analysis *(Section 5)*

- An analysis of STATS19 incident data has been examined for all impacts between motorcyclists and safety fences occurring on major roads in Scotland, England and Wales between 1992 and 2005.
- The analysis has revealed that a total of 1,584,605 accidents, of all types (i.e. not only safety barrier impacts), occurred on major roads (Motorway, A(M) and A roads) between 1992 and 2005. These accidents involved 3,029,100 vehicles of which 75.7% were cars and 8.4% were motorcycles The 1,584,605 accidents resulted in 2,233,288 individual casualties.
- Of these 31,590 (1.4%) received fatal injuries, 288,730 (12.9%) sustained serious injuries and 1,912,968 (85.7%) received slight injuries.
- Motorcyclists are the most vulnerable type of road users, with 27.2% receiving fatal or serious injuries, compared to 12.8% for car occupants.
- Safety fence impacts account for 3.3% of all casualties on the major roads of Great Britain.
- Of the 2,233,288 casualties, 73,202 resulted from an impact between a vehicle and a safety barrier system. Of these 1,497 received fatal injuries (4.7% of all fatal casualties), 10,199 were seriously injured (3.5% of all seriously injured casualties), and 61,506 were slightly injured (3.2% of all slight casualties).
- Whilst impacts with safety barriers are high severity impacts, other roadside features such as trees, telegraph/electricity poles and lamp posts are greater still in their severity, due to the point loading nature of any impact.
- Impacts result in fatal or serious injuries in between 50 and 70% of all impacts in which a motorcyclist impacts an item of roadside furniture. This can be compared to a range of 10 and 20% of car occupants.
- Of the 1,497 fatalities occurring as a result of an impact with a safety barrier (in the verge or in the median), 921 of the casualties were in cars (61.5%), 279 were on motorcycles (18.6%) and 297 were occupants in other vehicles (19.8%).
- However 2005 road traffic data shows that 79.5% of traffic in Great Britain consists of cars, 1.1% of traffic consists of motorbikes and 19.4% of traffic consists of other vehicles. Hence, although motorcyclists contribute only 1.1% of traffic, they account for 18.6% of fatal safety barrier casualties.

- A total of 2,559 impacts occurred between a motorcycle and a safety barrier between 1992 and 2005 (183 per year), of which 19.9 per year resulted in fatal injuries (10.8%), 82.5 per year resulted in serious injuries (45.1%) and 80.4 per year are resulted in slight injuries (44.0%).
- In terms of all motorcycle incidents on major roads, the severity of all motorcycle incidents is greater than for other types of vehicles (as seen previously), with 2.4% of casualties being reported as suffering fatal injuries, 24.8% serious injuries and 72.8% slight injuries.
- Compare these to the general severity percentages for all incidents, 1.4% fatal, 12.9% serious and 85.7% slight and the relative severity of motorcycle incidents, and motorcyclist to safety barrier impacts in particular, can be seen.
- Scottish roads have a lower rate of motorcyclist to safety fence incidents than the other constituents of Great Britain.
- In Scotland whilst the number of casualties resulting from motorcycle to safety barrier impacts is low (averaging 12 casualties per year), the overall trend is similar to that seen on the National level, i.e. an overall increase in the number of incidents.
- A detailed examination of the STATS19 data for impacts between motorcycles and safety barriers indicates that 46% of the impacts occurred with a median barrier.
- The majority of the median barrier impacts, 66.1%, were on roads limited to 70mph. Roads with a speed limit of 70mph also witnessed 33.6% of the motorcycle accidents with verge barriers, with 36.2% of such barrier incidents occurring on 60mph roads.
- The number of such accidents occurring on motorways is disproportionately high, however this may be for a number of reasons such as the road speed and/or the relative quantity of such barriers installed.
- The majority of incidents, and fatal incidents occur during daylight hours, during fine weather and with a dry road, with the majority of those injured being male aged between 20 and 29.

8.3 Fatal Accident Analysis *(Section 6)*

- Motorcycles involved in fatal incidents involving a safety barrier tend to be new motorcycles, typically between one and five years old. The engine size of these motorcycles is mostly above 1000cc. Motorcyclist impacts with safety barriers tend to occur between the hours of 11am and 1am with peaks between 3 and 6 pm which can be accounted for by increased levels of traffic on the roads at these times.
- The types of barrier struck in these types of accidents were mostly SSTCB with a very small proportion being WRSF. This may be due to the very small amount of WRSF used on the roads of England and Wales.
- The first point of contact made by the motorcyclist, with or without the bike was either the post or the rail element of the barrier. All of the 3 incidents involving a WRSF had the first element struck being the post. Over half of the riders had a known location before the accident of being on the motorcycle with half of these striking the rail first. For the majority of riders who were known to have come off the bike pre-impact a post was the first point of contact. Riders who struck posts were most likely to have been sliding pre-impact, whereas those who hit a rail were more likely to have been still riding on the bike.
- Of those impacts where the pre impact motion of the motorcyclist has been reported, 47% of impacts were due to the motorcyclist riding the motorcycle, 37% of the riders were sliding, 4% were rolling, and 12% were flying (i.e. not in contact with the ground).
- 90% of the fatalities were wearing a helmet pre-impact with half of these known to have remained on during and after the impact. Those that came off did so for a variety of reasons from not being secured sufficiently to being forced off by the force of the impact. Helmets are the item

of clothing which is the clearest to analyse due to its presence being recorded in most cases. Other items of clothing were less frequently recorded so conclusions are more difficult to draw.

- Multiple injuries and head injuries are the most common causes of death for all impacts regardless of the first contacted element. There was a high proportion of unknown cause of death due to the absence of post mortems in the fatal files. Multiple injuries are often recorded alongside the note of "The injuries are consistent with those sustained in a road traffic accident". When an analysis of injuries contributing to multiple was carried out 90% of fatalities with multiple injuries suffered severe trauma to the head. Most also suffered injuries to the thorax, usually involving fractured ribs and associated internal organ injuries.
- All the fatalities with cause of death as head were wearing helmets, with over half of the helmets remaining on through the impact.
- From the case studies of WRSF accidents no firm conclusions can be drawn as to whether these accidents are any different to other fences due to the small number of cases. From these 3 cases, it does appear that there is little difference between these cases and other fence related fatalities.
- An examination of the location of the 278 fatal incidents has shown that in 107 (38.5%) cases a barrier was struck on a straight length of road (i.e. a road of radius greater than 1km), whilst 89 (32.0%) occurred on a left hand bend and 53 (19.1%) occurred on a right hand bend.
- In addition, 17 incidents (6.1%) occurred on slip roads, and 9 (3.2%) occurred at a roundabout.
- Median barrier impacts are more likely to occur on left hand bends with a large radius, whilst verge barrier impacts are more likely to occur on right hand bends with a small radius.

8.4 Motorcyclist Impacts with Wire Rope Safety Fencing *(Section 7)*

- On Transport Scotland roads a 100% KSI rate has been reported for motorcyclists impacting wire rope safety fence between 1990 and 2005.
- On Highways Agency roads a 66.7% KSI rate has been reported for motorcyclists impacting a wire rope safety fence between 1992 and 2005.
- For impacts by motorcyclists with other barrier types, this KSI value is reduced to 58.3% in Scotland and 58.7% in England.
- These data indicate an increased risk to motorcyclists from wire rope safety fence, however other contributory factors to the accident such as impact speed, protection worn by the rider and mode of interaction between the rider and the fence were not taken into account during the analysis (as these data were not available).

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Motorcycle.com (1998); 'Motorcycle Online: Daily News 4/30/98' [http://www.motorcycle.com/mo/mcdaily98/day0430.html], accessed 13/03/2007

The Mercury (2006); 'Motorcyclists in favour of wire barrier' [http://mraa.org.au/forum/modules/news/article.php?storyid=373], accessed 20/03/2007

Motorcycle Riders Association Western Australia (MRA WA); 'Motorcycles and the Road Environment' [http://www.officeofroadsafety.wa.gov.au/Facts/papers_2001/paper_9/paper9.html], accessed 13/03/2007

National Highway Traffic Safety Administration; 'National Agenda for Motorcycle Safety' [http://www.nhtsa.dot.gov/people/injury/pedbimot/motorcycle/00-NHT-212-motorcycle/toc.html], accessed 13/03/2007

Stockholm Environment Institute (2006). 'Vision Zero', available from 'http://www.sei.se/visionzero/index.htm' on 20th July 2007

Unknown (2007). 'A2070 Cloverleaf Junction, Ashford, Kent – Provision of BikeGuard to Spplement Existing safety barrier', available from 'http://www.network.mag-uk.org/barriers/bikeguard.pdf' on 11th May 2007

VicRoads – Arrive Alive!; 'Special Projects for Motorcycle Safety' [http://www.arrivealive.vic.gov.au/motorcycle_levy/eng_tech.html], accessed 13/03/2007

Appendix A Summary of Questionnaire Responses

This Appendix summarises the responses received following the distribution of a questionnaire.

The questionnaire contained the following questions:

Section A: Research

1. Is/has your organisation been involved in research investigating impacts between motorcyclists and VRS?

[ ] Yes (continue to Question 2)
[ ] No (go to Section B)

2. Are published results available?

[ ] Yes (continue to Question 3)
[ ] No (go to Section B)

3. Please give details of these publications and how they can be obtained.

Section B: Testing

4. Is/has your organisation been involved in any full-scale testing to investigate impacts between motorcyclists and VRS?

[ ] Yes (continue to Question 5)
[ ] No (go to Section C)

5. To which standard have these devices been tested?

[ ] National Standard (continue to Question 6)
[ ] Test House's own Standard (continue to Question 6)
[ ] Manufacturer's own requirements [not standardised] (continue to Section C)

6. Are copies of this testing standard publicly available?

[ ] Yes (continue to Question 7)
[ ] No (go to Section C)

7. Please give details of how this/these can be obtained.

Section C: Manufacturing

8. Does your organisation manufacture 'motorcyclist-friendly' devices?

[ ] Yes (continue to Question 9)
[ ] No (go to Section D)

9. Please give details of the devices manufactured, including the name of the system.

Section D: Use of 'Motorcycle-friendly' devices

10. Are 'motorcycle-friendly' devices used within your country?

[ ] Yes (continue to Question 11)
[ ] No (go to Section E)
[ ] Don't know (go to Section E)

11. Is the use of these devices contained within a National requirement?

[ ] Yes (continue to Question 12)
[ ] No (go to Section E)

12. Are copies of these requirements publicly available?
[ ] Yes (continue to Question 13)
[ ] No (go to Section E)
13. Please give details of how this/these can be obtained.

Section E: Any Other Information
Please add any additional information which you feel may be of relevance to this project:

Section F: Your Details
Please give your details in the space below:

Name:
Organisation:
E-mail address:
Telephone Number:

Responses were received from a number of manufacturing, research and testing establishments, together with replies from motorcyclists' groups and Governmental organisations, and these are tabulated overleaf.

								Section A: Research				
Details of Respondent			Principal Organisation Type					1. Is/has your organisation been involved in research investigating impacts between motorcyclists and VRS?		2. Are published results available?		3. Please give details of these publications and how they can be obtained.
Country	Name	Organisation	Manufacturing	Research	Testing	Motorcycling Group	Government/Policy	Y	N	Y	N	
Austria	Edwin Hofbaur	MAG Austria				✓		✓		✓		Contact MAG Austria
Belgium	Joseph Marra	Arcelor	✓						✓			
	Erwin Steegmans	MAG Belgium				✓			✓			
Czech Republic	Miroslav Firt	AUAMK				✓			✓			
Denmark	Gunnar Skrydstrup	Motorcycle Touring Club				✓			✓			
	Peter Johnsen	On behalf of the Danish Road Directorate					✓	✓			✓	
Finland	Jarkko Valtonen	Helsinki University of Technology		✓				✓		✓		Research is in Finnish, but in 454 fatal run off road incidents, 50 involved a VRS, with 5 of these impacts with motorcyclists. Details of a literature search investigating motorcyclist-friendly devices was also sent
France	Jean Bloch	LIER			✓			✓			✓	
	Eric Thiollier	FFMC (Federation Francaise des Motards en Colere)				✓		✓			✓	The study was made by the french SETRA (Service d'Etude Technique des Routes et Autoroutes) http://www.setra.equipement.gouv.fr/
Germany	Rolf Frieling	Biker Union e.V				✓		✓		✓		Dr Ralf Kloeckner, BAST
Greece	Evi Kokkinou	Motorcyclists Federation of Greece				✓			✓			
Ireland	Linda O'Loideoin	Motorcyclist Action Group Ireland				✓			✓			
Italy	Marco Anghileri	Politecnico di Milano		✓				✓			✓	
	Riccardo Forte	Coordinamento Motociclisti				✓			✓			
Luxemburg	Rene Hilbert	LMI				✓			✓			
Netherlands	Wolter Jager	Prins Dokkum	✓					✓		✓		Manufacturer's brochure gives brief details of incidents
	Nico Perk	MAG-Netherlands				✓			✓			
Norway	Otto Kleppe	Norweigan Public Roads Administration					✓		✓			
	Morten Hansen	Norweigian Motorcycle Union				✓		✓		✓		Computer simulations of sliding rider colliding with exposed cable barrier post. Video and data available at Norwegian Motorcycle Union (NMCU)
Portugal	Rodrigo Ribeiro	GAM-Portugal				✓		✓		✓		GAM-Portugal has been involved in all of the "guardrails issue".
Spain	Angel Martinez	HIASA	✓					✓			✓	The European APROSYS Project is investigating this
	Alberto de Prado	CIDAUT			✓			✓			✓	The European APROSYS Project is investigating this
	Juan Manuel Reyes Martinex	AMM				✓			✓			
Sweden	Jan Wenall	VTI		✓				✓		✓		Four links to reports on the Internet provided
	Peter Begendahl	Trinity Industries	✓					✓			✓	
	Maria Nordqvist	The Swedish Motorcyclist's Association				✓			✓			
Switzerland	Daniel Schuler	IG Motorrad				✓			✓			
England	Phil Bigley	Quixote Europe	✓						✓			
	Trevor Magner	British Motorcylclists Feredation				✓			✓			
	Trevor Baird	Motorcycle Action Group UK				✓			✓			

Details of Respondent			Principal Organisation Type					Section B: Testing 4. Is/has your organisation been involved in any full-scale testing to investigate impacts between motorcyclists and VRS?		5. To which standard have these devices been tested?			6. Are copies of this testing standard publicly available?		7. Please give details of how this/these can be obtained.
Country	Name	Organisation	Manufacturing	Research	Testing	Motorcycling Group	Government/Policy	Y	N	National	Test House	Manufacturer	Y	N	
Austria	Edwin Hofbaur	MAG Austria				✓		✓				✓		✓	
Belgium	Joseph Marra	Arcelor	✓						✓						
	Erwin Steegmans	MAG Belgium				✓			✓						
Czech Republic	Miroslav Firt	AUAMK				✓			✓						
Denmark	Gunnar Skrydstrup	Motorcycle Touring Club				✓			✓						
	Peter Johnsen	On behalf of the Danish Road Directorate					✓		✓						
Finland	Jarkko Valtonen	Helsinki University of Technology		✓					✓						
France	Jean Bloch	LIER			✓			✓			✓		✓		Contact LIER
	Eric Thiollier	FFMC (Federation Francaise des Motards en Colere)				✓		✓		✓			Don't know		Testing house was LIER (Laboratoire de l'Inrets pour l'Equipement Routier); http://www.lier.fr/ Details on the test procedure: http://moto29.objectis.net/Infrastructure/homologation_glissieres/document_view
Germany	Rolf Frieling	Biker Union e.V				✓			✓	✓			✓		EN1317
Greece	Evi Kokkinou	Motorcyclists Federation of Greece				✓			✓						
Ireland	Linda O'Loideoin	Motorcyclist Action Group Ireland				✓			✓						
Italy	Marco Anghileri	Politecnico di Milano		✓				✓		✓	✓	✓		✓	
	Riccardo Forte	Coordinamento Motociclisti				✓			✓						
Luxemburg	Rene Hilbert	LMI				✓			✓						
Netherlands	Wolter Jager	Prins Dokkum	✓					✓			✓		✓		Contact LIER
	Nico Perk	MAG-Netherlands				✓			✓						
Norway	Otto Kleppe	Norweigan Public Roads Administration					✓		✓						
	Morten Hansen	Norweigian Motorcycle Union				✓			✓						
Portugal	Rodrigo Ribeiro	GAM-Portugal				✓			✓						
Spain	Angel Martinez	HIASA	✓					✓		✓			✓		Spanish Standard UNE 135900 is used
	Alberto de Prado	CIDAUT			✓			✓		✓			✓		Spanish Standard UNE 135900 is used
	Juan Manuel Reyes Martinex	AMM				✓		✓		✓			✓		You can get the National Standard UNE 135900 into the web site; www.aenor.es - standard and publications - This document is available only in Spanish, but we are waiting for an English version soon.
Sweden	Jan Wenall	VTI		✓					✓						
	Peter Begendahl	Trinity Industries	✓						✓						
	Maria Nordqvist	The Swedish Motorcyclist's Association				✓			✓						
Switzerland	Daniel Schuler	IG Motorrad				✓			✓						
England	Phil Bigley	Quixote Europe	✓						✓						
	Trevor Magner	British Motorcylclists Feredation				✓			✓						
	Trevor Baird	Motorcycle Action Group UK				✓			✓						

								Section C: Manufacturing			Section D: Use of 'Motorcycle-friendly' devices						
Details of Respondent			Principal Organisation Type					8. Does your organisation manufacture 'motorcyclist-friendly' devices?		9. Please give details of the devices manufactured, including the name of the system.	10. Are 'motorcycle-friendly' devices used within your country?		11. Is the use of these devices contained within a National requirement?		12. Are copies of these requirements publicly available?		13. Please give details of how this/these can be obtained.
Country	Name	Organisation	Manufacturing	Research	Testing	Motorcycling Group	Government/Policy	Y	N		Y	N	Y	N	Y	N	
Austria	Edwin Hofbaur	MAG Austria				✓			✓		✓			✓			New RVS 5.23 (Guidelines for road and transport/motorcycle friendly devices) is in progress, finalizing is expected end of 2007; RVS are usually the forerunner of a transport code. MAG Austria is a member of this RVS committee
Belgium	Joseph Marra	Arcelor	✓						✓		✓		✓		✓		Contact name at Belgium Road Administration given
	Erwin Steegmans	MAG Belgium				✓			✓		✓			✓			
Czech Republic	Miroslav Firt	AUAMK				✓			✓			✓		✓			
Denmark	Gunnar Skrydstrup	Motorcycle Touring Club				✓			✓			✓					
	Peter Johnsen	On behalf of the Danish Road Directorate					✓		✓			✓					
Finland	Jarkko Valtonen	Helsinki University of Technology		✓					✓		✓			✓			There is currently a trial of two devices (started in December 2006) to assess durability in cold climates
France	Jean Bloch	LIER			✓				✓		✓		✓		✓		Contact the French DoT (DSCR)
	Eric Thiollier	FFMC (Federation Francaise des Motards en Colere)				✓			✓		✓		✓		✓		http://catalogue.setra.equipement.gouv.fr/_ftp/Notes_info/CSEE/DT2100.PDF
Germany	Rolf Frieling	Biker Union e.V				✓			✓	Unterfahrschutz "Modell Euskirchen" - Contact person: Mr. Maurer, Safe German Guardrail Technology SGGT	✓		✓		✓		Attached to questionnaire
Greece	Evi Kokkinou	Motorcyclists Federation of Greece				✓			✓			✓					
Ireland	Linda O'Loideoin	Motorcyclist Action Group Ireland				✓			✓			✓					
Italy	Marco Anghileri	Politecnico di Milano		✓							✓			✓			
	Riccardo Forte	Coordinamento Motociclisti				✓			✓		✓			✓			
Luxemburg	Rene Hilbert	LMI				✓			✓		✓			✓			
Netherlands	Wolter Jager	Prins Dokkum	✓					✓		Details of the 'Moto-Shield' provided	✓			✓			
	Nico Perk	MAG-Netherlands				✓			✓		✓			✓			
Norway	Otto Kleppe	Norweigan Public Roads Administration					✓		✓		✓			✓			
	Morten Hansen	Norweigian Motorcycle Union				✓			✓		✓			✓			
Portugal	Rodrigo Ribeiro	GAM-Portugal				✓			✓		✓		✓		✓		a) GAM-Portugal always talked to all of the political parties in the national parliament. A Portuguese member of parliament and member of GAM (Rodrigo Ribeiro) made a public statement by riding his own bike from the Portuguese Parliament to the European Parliament to talk to the European M.Ps about this problem. In Brussels, the Portuguese M.P. was accompanied to the E.P. by FEMA, that did a good lobbying there. Back in Portugal, he made the Portuguese law 33/2004, that forces all the Portuguese authorities to protect ALL the guardrails in every new road opened to traffic, and to, progressively, protect the old roads, starting by the most dangerous spots. Today, that work is being done in all of the country, and the system of protection being used is the "double metal skirt" on the guardrails (but, if a better system appears, the law can also use it). b) The Portuguese law (33/2004) is public on the Internet (www.parlamento.pt) (lei 33/2004). A copy will be sent to FEMA with possible translation from the Portuguese language (attached to questionnaire)
Spain	Angel Martinez	HIASA	✓					✓		HIASA Commercial name SPM-ES4 and SPM-ES2	✓		✓		✓		Spanish Guideline OC. 18/2004 - contact name at Spanish Road Administration given
	Alberto de Prado	CIDAUT			✓				✓		✓		✓			✓	
	Juan Manuel Reyes Martinex	AMM				✓			✓		✓			✓			
Sweden	Jan Wenall	VTI		✓					✓			✓					
	Peter Begendahl	Trinity Industries	✓						✓			✓					
	Maria Nordqvist	The Swedish Motorcyclist's Association				✓			✓			✓					
Switzerland	Daniel Schuler	IG Motorrad				✓		✓			✓			✓			
England	Phil Bigley	Quixote Europe	✓						✓								
	Trevor Magner	British Motorcylclists Feredation				✓			✓		✓			✓			
	Trevor Baird	Motorcycle Action Group UK				✓			✓		✓		✓		✓		TD19-06 contains the requirements

Details of Respondent			Principal Organisation Type					Section E: Any Other Information
Country	Name	Organisation	Manufacturing	Research	Testing	Motorcycling Group	Government/Policy	
Austria	Edwin Hofbaur	MAG Austria				✓		
Belgium	Joseph Marra	Arcelor	✓					
	Erwin Steegmans	MAG Belgium				✓		
Czech Republic	Miroslav Firt	AUAMK				✓		
Denmark	Gunnar Skrydstrup	Motorcycle Touring Club				✓		
	Peter Johnsen	On behalf of the Danish Road Directorate					✓	
Finland	Jarkko Valtonen	Helsinki University of Technology		✓				
France	Jean Bloch	LIER			✓			
	Eric Thiollier	FFMC (Federation Francaise des Motards en Colere)				✓		I worked on the FEMA Crash Barrier Project and wrote the FEMA report on the subject (available at http://www.fema.ridersrights.org/crashbarrier) A French translation of this report is available from FFMC Office in case of need. As representative of French riders, I also contributed with the French authorities in a working group to define the test criterias for motorcycle friendly crash barrier
Germany	Rolf Frieling	Biker Union e.V				✓		A working group of road engineers is currently finalising a document called "Instructions to improve road safety for motorcylists", which will cover all aspects of motorcycle friendly road infrastructure.
Greece	Evi Kokkinou	Motorcyclists Federation of Greece				✓		
Ireland	Linda O'Loideoin	Motorcyclist Action Group Ireland				✓		
Italy	Marco Anghileri	Politecnico di Milano		✓				
	Riccardo Forte	Coordinamento Motociclisti				✓		Crash Barrier Protector and/or M/C friendly devices have been recently adopted by some local administrations, as an experiment and only on certain roads. For example: Provincia di Bolzano, Provincia di Modena, Provincia di Perugia.
Luxemburg	Rene Hilbert	LMI				✓		The pressure by the Luxemburg motorcyclist association (LMI) since 1988 made it possible to install MC-friendly devices throughout the country.
Netherlands	Wolter Jager	Prins Dokkum	✓					
	Nico Perk	MAG-Netherlands				✓		The Dutch Ministry of Transport has made an inventory of the motorways to define in which sections the safety for motorcyclists can be improved by installing motorcycle friendly crash barriers. This project will start with curves in accesses and exits. The official kick-off will be this year. The minister of transport also has stated in 2005 that cable barriers will be banned from Dutch roads. All existing cable barriers have been removed. Some provinces and cities in the Netherlands already installed MC-friendly crash barriers after being advised by us, anticipating future CEN-directives that have to replace CEN-1317.
Norway	Otto Kleppe	Norweigan Public Roads Administration					✓	Computer simularions of motorcycle/motorcyclist impacts have been performed
	Morten Hansen	Norweigian Motorcycle Union				✓		Only selected test sections have been equipped with motorcycle friendly sub-rails
Portugal	Rodrigo Ribeiro	GAM-Portugal				✓		a) GAM-Portugal has always defended that the Portuguese guardrails had to be protected and won the support of all the Portuguese public opinion, even of those citizens that do not ride motorcycles. b) GAM-Portugal is always supervising the work, all over the country, and if a Portuguese motorcyclist detects a road without the necessary protection, he can call GAM-Portugal that reports the situation to the authorities (political or constructors) and they correct the problem. (Example: The roads next to the GAM-headquarters was being built without the protections. After the GAM-contacts, the constructer started the protection in two days☺) c) It would be perfect if, in a near future, the protection of the guardrails was an imposition by "European Law" and not only by "national laws". This way, all countries would be protected, instead of waiting for each national parliament to understand the problem and accept creating a specific law.
Spain	Angel Martinez	HIASA	✓					
	Alberto de Prado	CIDAUT			✓			
	Juan Manuel Reyes Martinex	AMM				✓		What we have in Spain is a norm that advise the use of this devices, but it is not an obligatory law.
Sweden	Jan Wenall	VTI		✓				In a recent process where the National Road Administration asked for quotations on future guardrail delivery from companies, a kind of procedure to evaluate a more motorcycle-friendly design was used. Rounded corner and no small extruding hooks and fastening devices got a kind of advantage due to a point system. Motorcycle-friendly designs was allowed to be up to 25 % more expensive than other equal systems. Unfortunately I have not found those requirement on the internet in English. Might be able to come back to that later. I will have to ask for specifications within the SNRA.
	Peter Begendahl	Trinity Industries	✓					
	Maria Nordqvist	The Swedish Motorcyclist's Association				✓		We've started to work with Vägverket, The National Swedish Road Administration in order to get more motorcycle friendly crash barriers and a more motorcycle friendly infra structure over all. We will work out guidelines of where to use motorcycle friendly devices and also to look for a device. Then there is also a need for a national standard for mc-friendly devices. A company has come forward which is interested in this. A WG will be formed. We're looking at the guidelines from FEMA., France and Spain. We are really interested in a translation of the Spanish standard.
Switzerland	Daniel Schuler	IG Motorrad				✓		The particular use of "motorcycle-friendly" devices in Switzerland is in the responsibility of the local authorities e.g. the offices for road operation. Devices like foam impact attenuators or additional metal profiles, which are covering the posts of VRS, are sometimes used on routes with frequent motorcycle traffic.
England	Phil Bigley	Quixote Europe	✓					
	Trevor Magner	British Motorcylclists Feredation				✓		The Highways Agency which leads on vehicle restraints has been trialing "Bikeguard" to protect riders from the support posts of existing Tension Corrugated Beam safety fence and propose to roll it out nationally. The HA is also increasingly using continuous cast concrete in central reserves and reducing the use of Wire Rope Safety Fence (cable barrier). The BMF in sitting on the National Road Users Committee of the HA has consistently requested more research on impacts with motorcycles/motorcyclists and for standards cover under EN 1317 for add-ons to protect riders from support posts. The HA while paying lip service to our concerns has not been very dynamic and has now introduced end terminals which are not very rider friendly – and not liked by truck drivers who find them distracting. Apparently they have EN 1317 approval!
	Trevor Baird	Motorcycle Action Group UK				✓		MAG "Vehicle Restraint Systems, Safety Fences, Crash Barriers, Motorcyclists" which is available at http://www.network.mag-uk.org/crashbarriers2005/MAGcrashbarrier2005.pdf Also a page of information at http://www.network.mag-uk.org/barriers/index.html

Appendix B Motorcyclist Protection Systems

This Appendix gives details of some of the commercial products designed with the safety of motorcyclists in mind. Product details have been extracted from either:-

- The manufacturer's website (reported by product),
- 'A2070 Cloverleaf Junction, Ashford, Kent – Provision of BikeGuard to Supplement Existing Safety Barrier' (Unknown, 2007), or
- 'Safer Restraint Systems for Motorcyclists, Literature Research' by Ute Grosse, Laboratory of Highway Engineering, Helsinki University of Technology (2007), or
- 'Final report of the Motorcyclists and Crash Barriers Project, v2.00' by the Federation of European Motorcyclists' Associations (FEMA, 2000).

B.1 BikeGuard

Details of Manufacturer:

Name:	Highway Care Ltd
Address:	The Highlands, Detling Hill, Detling, Maidstone, Kent. ME14 3HT.
Tel:	01622 734215
Fax:	01622 735106
Email Address:	info@highwaycare.co.uk
Internet Address:	www.highwaycare.co.uk
Type of system:	Retro-fitting Secondary Rail

Additional Information:

The BikeGuard is a light steel beam that can be attached to standard UK corrugated beam safety barriers and open box beam systems to improve the safety performance of these barriers when impacted by motorcyclists.

BikeGuard has been tested to BS EN 1317 part 2 and approved by the Highways Agency for use on the UK trunk road network. ("Approved Road Restraints", - Miscellaneous Section).

BikeGuard is manufactured in galvanised steel, and is fixed to the barrier with specially shaped brackets which attach to the rear of the barrier rail, allowing the BikeGuard to perform independently of the barrier during impact. The BikeGuard system utilises slotted holes and a hanging bracket to enable horizontal and vertical adjustment during installation. The brackets are secured to the back of the barrier with purpose designed fixings to suit different barrier types.

B.2 BikeGuard Euskirchen

Details of Manufacturer:

Name:	Strassenausstattungen GmbH (SGGT)
Address:	Bahnhostrasse 35, 66564 Ottweiler, GERMANY
Tel:	+49 (6824) 308 0
Fax:	+49 (6824) 308 131
Email Address:	info@sggt.de
Internet Address:	http://www.sggt.de/
Type of system:	Retro-fitting Secondary Rail

Additional Information:

Also sold by the German company Volkmann & Rossbach

Characteristics:

"Elastic" device based on French structures

steel plate, 2.5 mm thick

elastic attachment to existing beam via two hang-up plates per 4 m

elastic attachment absorbs impact energy and breaks away in the case of a car or heavy vehicle impact (preventing vehicle ramping)

No attachment to the existing posts

Lapped beam joints (so that they can not open during an impact)

Additional posts prevent the device from bending back during an impact

Space between existing guardrail beam and protection beam should not be bigger than 50 mm to prevent that extremities get stuck

B.3 CUSTOM (Containment Urban System for Motorcyclists)

Details of Manufacturer:

Name: C.S.M S.p.A

Address: Via di Castel Romano, 100; 00128 - Rome - ITALY

Tel: +39-06-50551

Fax: +39-06-5055202

Email Address: c.primerano@c-s-m.it

Internet Address: http://www.c-s-m.it/

Type of system: EN1317 safety barrier with motorcyclist protection incorporated

Additional Information:

This safety barrier design has incorporated motorcyclist protection into its fundamental design, rather than provide it through the retro-fitting of additional components.

Full scale impact testing of the system to EN1317 has been carried out, giving the following results:

Testing to EN1317-1&2

Severity Level	**TB11**	**TB32**	**Limits**
ASI	0.9	0.9	1.0 (Class A) 1.4 (Class B) 1.9 (Class C)
THIV	26kph	24kph	33kph
PHD	10g	12g	20g
CEN Exit Box	Pass	Pass	N/A
Working Width	W2	W3	N/A

Testing has also been completed using the LIER test protocol for the assessment of motorcyclist protection, giving the following results:

LIER test procedure results for Motorcyclists

	Test 1	**Test 2**	**Limits**
Dummy	Hybrid III	Hybrid III	
Impact angle	30 deg	30 deg	
Dummy position in relation to barrier axis	Tilted to 30 deg	Parallel	
Impact point	Head of dummy	Side of dummy	
Speed	60kph	60kph	
Head Injury Criteria (HIC)	119	209	1000
Neck Compression force	80daN	80daN	400daN
Neck Traction force	280daN	220daN	330daN
Neck Shearing force	150daN	260daN	330daN

B.4 DR46

Details of Manufacturer:

Name:	Snoline
Address:	Via F. Baracca 19/23, 20056 Trezzo sull'Adda (MI), Italy
Tel:	+39 02909961
Fax:	+39 0290996200
Email Address:	info@snoline.com
Internet Address:	www.snoline.com
Type of system:	Retro-fitting Secondary Rail

Additional Information (extracted from the Snoline Website):

'The DR 46 consists of an empty body made of a plastic material (polyethylene) with a "wave" section.

The chosen shape and the material used allow a plastic deformation and an air compression that partially redirect and absorb the crash against the bearing structure of the barrier (posts of a "C" or "I" section). That constitutes, generally, the greatest source of danger for a motorcyclist during the fall.

The device is modular and easy to install, with a simple attachment mechanism. Moreover, its structure concurs to easily follow also the small diameter curves.

DR 46 has a standard yellow colour but, on request, it is available in various colours.'

Size:	Intermediate element:	Terminal element:
	L 3320 mm	L 590 mm
	W 330 mm	W 321 mm
	H 215 mm	H 215 mm

B.5 Ecran Motard

Details of Manufacturer:

Name:	Sec Envel
Address:	18, rue Pasteur; 77250 Veneux les Sablons, France
Tel:	+33 160 70 93 93
Fax:	+33 160 70 99 99
Email:	secenvel@wanadoo.fr
Internet Address:	http://catalogues.kompass.com
Type of system:	Retro-fitting Secondary Rail

Additional Information:

An additional rail (flat in profile) is attached below the current longitudinal rail. The system can be applied to any post and rail system (including those with wooden posts, and parapets).The system is adjustable in height (between 18 and 38cm; 31 and 37cms are the standard heights for the system).

Testing with dummies has revealed a HIC of 162, well below the 1000 injury threshold value and 233 for the 2X version.

B.6 Leitschienen-Vorhang

Details of Manufacturer:

Name: Dr. Knut Spelitz

Address: Austria

Internet Address: http://www.general-solutions.at/landeszeitung/site-files/607/php/detail.php?artnr=5218&ukatnr=10311&ukatname=regierung

Type of system: Rubber curtain (made of recycled tyres)

Additional Information:

Characteristics:

- Can be installed in front of any guardrail over its whole height
- Incorporates embedded steel strip for additional stiffness
- Additional absorber in front of the posts
- No repercussion for impacting motorcyclists
- The curtain has a good absorbing effect for impacting cars too

Other information:

Performance was tested by TU Graz

Still in test phase

Test road in Austria: 540 m long, installation costs there were 30.000 € (45 € per m)

B.7 Motorail

Details of Manufacturer:

Name:	Solosar
Address:	3, rue Guillaume Schoettke, Z.I.-Parc d'Activites du Grand Bois, F-57200 Sarreguemines, France
Tel:	+33 387 98 56 04
Fax:	+33 387 95 55 93
Email Address:	info@solosar.fr
Internet Address:	www.solosar.fr
Type of system:	Retro-fitting Secondary Rail

Additional Information:

This flat rail system is attached below the rail of the existing safety fence system to reduce the severity of impact between motorcyclists and safety fence posts.

B.8 MotoRail Euskirchen

Details of Manufacturer:

Name:	Volkmann and Rossbach
Address:	Hohestrasse 9-17, D - 56410 Montabaur, GERMANY
Tel:	+49 (2602) 13 50
Fax:	+49 (2602) 135 490
Email Address:	info@volkmann-rossbach.de
Internet Address:	http://www.volkmann-rossbach.de/
Type of system:	Retro-fitting Secondary Rail

Additional Information:

Characteristics:

- Most used under-run protection device in Germany
- Attachment to beam via hang-up plate every 1.33 m
- Device joints are placed in front of guardrail posts
- 50 mm space between device and beam
- Under-run protection can be installed at other steel guardrails too
- Was not tested yet, but is seen as potential
- Also sold by the German company SGGT

B.9 MotoRail Feldberg

Details of Manufacturer:

Name:	Volkmann and Rossbach
Address:	Hohestrasse 9-17, D - 56410 Montabaur, GERMANY
Tel:	+49 (2602) 13 50
Fax:	+49 (2602) 135 490
Email Address:	info@volkmann-rossbach.de
Internet Address:	http://www.volkmann-rossbach.de/
Type of system:	Retro-fitting Secondary Rail

Additional Information:

Characteristics:

- Beam length: 4 m
- Sigma posts every 2 m
- Box beam as upper part and under run protection
- Thickness of the lower steel beam plate: 2 mm
- Under-run protection can be installed on other steel barrier systems
- Installation on a curve with a small radius might be difficult
- Particularly suitable for winding and forested tracks with a high percentage of motorcycles
- Especially suitable to be used as protection against tree impacts

Other information:

Pilot project on the Feldberg near Frankfurt is currently in progress (more than 300 bikers a day use the area during weekend periods)

B.10 MOTO-SHIELD

Details of Manufacturer:

Name:	Prins Dokkum
Address:	PO Box 4, NL-9100 AA Dokkum, The Netherlands
Tel:	+31 (0) 519 29 85 55
Fax:	+31 (0) 519 29 81 37
Email Address:	w.jager@prinsdokkum.com
Internet Address:	http://www.verkeersveiligheidssystemen.nl
Type of system:	Retro-fitting Secondary Rail

Additional Information (extracted from Prins Dokkum documentation):

Successfully tested in accordance with the European general guideline CCT RW 99.

MOTO-SHIELD ensures that a fallen motorbike rider is prevented from sliding or getting trapped under the guard rail construction, and simply slides in parallel along its length.

MOTO-SHIELD consists of a standard flat board with inverted edges which can be mounted with the aid of brackets under any type of guard rail construction.

The boards have a working length of 4 metres. MOTO-SHIELD has a post distance mounting of 4 metres, centre to centre. On curves or bends the boards should be mounted 1.33 metres apart, centre to centre.

MOTO-SHIELD is a light-weight construction which is simple to assemble and to align even on bends and curves. As the brackets come with slotted holes the actual differences in the distance between the posts can be easily adjusted. Repair after an accident is often not required owing the “forgiving” nature of its design.

Benefits and advantages of using MOTO-SHIELD:

- prevents serious injury to fallen motorbike riders;
- especially suited for relatively sharp bends at access- and exit roads;
- better performance of the system and less danger of getting trapped as a result of the positioning of the bracket midway on the post;
- boards and distance pieces do not have to be loosened, thereby saving time;
- replacement of the fixing material therefore is unnecessary and
- possible re-use of parts after accident damage

B.11 Mototub

Details of Manufacturer:

Name:	Sodirel
Address:	Route d'Orange, 84 100 UCHAUX, FRANCE
Tel:	04 90 11 16 00
Fax:	04 90 51 62 40
Email Address:	contact@sodirel.somaro.com
Internet Address:	www.sodirel.com
Type of system:	Retro-fitting Secondary Rail

Additional Information (extracted from the Sodirel web site):

Attaches to individual post protectors and forms two additional rails (with circular cross-sections) beneath the original safety fence longitudinal.

The MOTOTUB is made of polyethylene, the raw materials for which have been recovered from household waste. Recycled materials can account for up to 75% of the finished product.

Although only a limited range of colours is possible, the supports and tubes can be of different colours (black, grey, imitation wood, green, etc.)

Testing with dummies has revealed a HIC of 296, below the 1000 injury threshold value.

B.12 RailPlast

Details of Manufacturer:

Name:	Sodilor
Address:	Parc industriel Sud - Z.I. Neuwald, 18 rue René François Jolly - BP 40739 – 57207, France
Tel:	+33 387 98 25 88
Fax:	+33 387 98 46 56
Email Address:	halb.j@sodilor.fr
Internet Address:	www.sodilor.fr
Type of system:	Retro-fitting Secondary Rail

Additional Information:

The system consists of distinct units which fit around the posts of the safety barrier system. An additional rail is then fitted to these units to form a second rail.

B.13 Motorcyclist Protection Device (SPM – ES4)

Details of Manufacturer:

Name:	HIASA
Address:	Poligono Industrial de Cancienes, s/n 33470, Corvera, Asturias, Spain
Tel:	+34 985 128 200
Fax:	+34 985 505 361
Email Address:	ingeneria_hiasa@gonvarri.com
Internet Address:	www.hiasa.es
Type of system:	Retro-fitting Secondary Rail

Additional Information:

The SPM system is made of S235JR grade hot-rolled steel sheet according to EN 10025 and hot dip galvanized according to EN ISO 1461.

The SPM system has been tested in full scale crash tests with a dummy, in accordance with the requirements of the LIER test protocol.

The H.I.C. rate (Head Injury Criteria), which evaluates the risk level of injuries in the head, was reported as 178 for a post impact and 93 for an impact between posts. The maximum permissible value is 1000.

The system has also met the requirements of EN1317-2, N2 containment level.

B.14 SPIG Crash Absorber

Details of Manufacturer:

Name:	Strassenausstattungen GmbH (SGGT)
Address:	Bahnhofstrasse 35, 66564 Ottweiler, GERMANY
Tel:	+49 (6824) 308 0
Fax:	+49 (6824) 308 131
Email Address:	info@sggt.de
Internet Address:	http://www.sggt.de/
Type of system:	Post Protection System

Additional Information:

Characteristics:

- Able to case sigma and IPE-100 posts
- Height: 490 mm (height is variable)

B.15 SPU Crash Absorber

Details of Manufacturer:

Name:	Volkmann and Rossbach
Address:	Hohe Straße 9 – 17, 56410 Montabaur, Germany
Tel:	+49/ (0) 26 02/ 13 50
Fax:	+49/ (0) 26 02/ 13 54 90
Email Address:	info@volkmann-rossbach.de
Internet Address:	www.volkmann-rossbach.de
Type of system:	Post Protection System

Additional Information:

A two-piece system design to protect individual posts – the system does not incorporate a bottom rail as with some other motorcyclist protection systems.

B.16 Unterfahrschutz/Anfahrschutz

Details of Manufacturer:

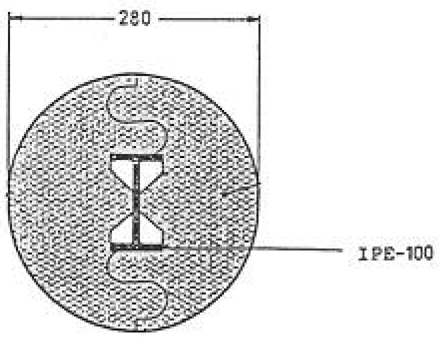
Name:	Outimex AG
Address:	Landshuter Straße 1, D-10779 Berlin, GERMANY
Tel:	+49(0) 30 21 24 91 11
Fax:	+49(0) 30 21 24 91 50
Email Address:	info@outimex.de
Internet Address:	http://www.outimex.de/
Type of system:	Retro-fitting Secondary Rail

Additional Information:

Attachable at the steel guardrail “Primus”, also produced by Outimex

B.17 MAG post protection design (FEMA, 2000)

Two models of crash barrier impact attenuator covering barrier posts exist. They are made of foam (polystyrene, polyurethan or similar material). They have been been installed on several hundred of kilometers in both Austria and Germany. Some have also been used in Luxembourg.



Dohman (1987) reported that protective devices of these types have been installed on about 80 kilometres of guardrail in several federal states of Germany.

They prevent contact with posts edges, and absorb part of the impact energy.

Their positive effect is however reduced with higher speeds of impact.

They are very easy to install, and the indicated durability is 4 years. In mountainous regions, they are often removed during winter to prevent damage by snowploughs.

In Portugal, some initiatives by riders' groups have installed used tyres on the posts of metal barrier to reduce impact severity through covering the edges of the posts.

Appendix C STATS19 Data

C.1 STATS19 background

Statistics on personal injury road accidents are published annually on the Department for Transport's website (Department for Transport, 2007-A). These data are based on information collected by the police in a system known as STATS19, named after the number of the first questionnaire issued when the system was introduced in 1949 (Department for Transport, 2007-B). STATS19 covers road accidents involving injury occurring on the public highway (including footways) in which at least one road vehicle, or a vehicle in collision with a pedestrian, is involved which becomes known to the police within 30 days of its occurrence and conversely, those which are not reported to the police are not contained within the statistics. The vehicle need not be moving at the time of the accident and accidents involving stationary vehicles and pedestrians or users are included. Excluded from STATS19 are confirmed suicides, death from natural causes, injuries to pedestrians with no vehicle involvement (e.g. a fall on the pavement), and accidents in which no one is injured but a vehicle is damaged.

From the 1st January 2005, a new version of the STATS19 form, STATS20 has been used to collate the accident data. In general there are very little changes between the two reporting procedures however the STATS20 form now also requires the reporting of contributory factors to the accident.

The STATS19 system collects some fifty data items for each accident, including the time, location and severity, the type of vehicle(s) involved and the vehicle movement at the time of the accident and some information on the drivers and casualties involved. An example of the STATS20 data collection form can be located on the website of the Department for Transport (2004).

The most recent accidents considered in this particular study took place in 2005, due to STATS19/20 information and police reports generally only being available once a verdict has been reached in any court proceedings arising from the accident.

C2 Definition of Casualty Severity

Accidents are classed within the STATS19 reporting process as 'fatal', 'serious' or 'slight', depending on the severity of the most seriously injured casualty in the accident:

'Fatal' injuries include only those cases where death occurs in less than 30 days as a result of the accident. 'Fatal' does not include death from natural causes or suicide.

Examples of 'Serious' injuries are: Fracture, internal injury, severe cuts, crushing, burns (excluding friction burns), concussion, severe general shock requiring hospital treatment, detention in hospital as an in-patient, either immediately or later, injuries to casualties who die 30 or more days after the accident from injuries sustained in that accident.

Examples of 'Slight' injuries are: Sprains not necessarily requiring medical treatment, neck whiplash injuries, bruises, slight cuts, slight shock requiring roadside attention. (Persons who are merely shaken and who have no other injury should not be included unless they receive or appear to need medical treatment). (Department for Transport, 2004).

C3 Levels of reporting in STATS19

The high standards that are achieved in the sometimes complex STATS19 reporting system reflect the efforts of local authorities and police forces to report to the standard national requirements. However while very few, if any, fatal accidents do not become known to the police, research conducted on behalf of the Department for Transport in 1996 (Simpson, 1997) showed that a proportion of non-fatal injury accidents are not reported within the STATS19 system. This is partly because in certain kinds of personal injury road accidents, there is no legal duty to report the accident to the police.

Further studies have been undertaken which also provide estimates of this shortfall and the most recent work on reporting levels has been drawn together in a report commissioned by the Department for Transport and published in June 2006 (Department for Transport, 2006-A).

The report concluded that 'reporting was higher for the more serious injuries (61%) compared with only about half of the slightly injured casualties being known to the police.'

STATS19 data can be validated with comparison to other sources of data, at either a local or national level. One of the most recent studies published by the Department for Transport compares hospital "in-patient" data with "serious injuries" in STATS19. Information on casualties admitted to hospital as in-patients in England is contained on the Hospital Episodes Statistics (HES) database held by the NHS (Department for Transport, 2006-B). The external causes of injury for all admissions are recorded allowing those patients injured in road accidents to be identified.

Any road accident casualty admitted as an in-patient to a hospital overnight is recorded as "seriously injured" on STATS19. However, an injured casualty is recorded as seriously injured by the police on the basis of information available within a short time of the accident. This generally will not reflect the results of a medical examination, but may be influenced according to whether the casualty is likely to be hospitalised or not. Additionally, the police are not necessarily told that a casualty has been admitted to hospital, nor is there a duty on the hospital to reveal this personal information about an individual if it is requested.

The report comparing HES and STATS19 (Department for Transport, 2006-B) uses the similarity between the two datasets to compare trends between the two series. The results of the report show that trends in the number of road accident casualties admitted to hospital as recorded in HES shows a lower fall in recent years than the number of seriously injured casualties recorded in STATS19 data.

Such differences may reflect one or a combination of the following:

- Reduced reporting of accidents by the public to the police (as mentioned earlier there is not a duty to report all personal injury road accidents to the police);
- A genuine decline in the number of less severe, non hospitalised casualties which are still classed as "serious" in STATS19 - many such cases will be handled in A&E, and therefore are not recorded in the HES statistics;
- An increase in the proportion of road casualties going to a hospital;
- Changes in hospitals' practices or in how they record their data, particularly better reporting to the comparatively new HES system over time.

The work done so far does not indicate which of these factors (or others) lead to the difference between the two trends and the Department for Transport will shortly be commissioning a more extensive project to address this. This project should allow a better idea of the strengths and weaknesses of each series and may also give a clearer picture as to whether the level of reporting in STATS19 has changed over time. For the reasons given above, any conclusions drawn from a simple comparison of aggregate STATS19 and HES annual and trend data could be misleading.

While it is important to get a good estimate of the level of reporting, this under reporting does not necessarily mean that STATS19 does not give a reasonable estimate of accident trends. However if there were a systematic change in the levels of reporting, this would cause a problem in monitoring trends.

C.4 Overview of Data

ACCIDENTS		
		%age
Fatal	28379	1.79
Serious	236228	14.91
Slight	1319998	83.30
TOTAL	**1584605**	**100.00**

CASUALTIES

	Fatal	%age	Serious	%age	Slight	%age	Total	%age	%age
Car	21720	1.29	193908	11.47	1474356	87.24	1689984	100.00	75.67
Motorbike	4529	2.41	46533	24.80	136551	72.78	187613	100.00	8.40
HGV	2878	2.57	17044	15.19	92274	82.24	112196	100.00	5.02
Bus/coach	621	0.76	7452	9.12	73679	90.13	81752	100.00	3.66
Other	1835	1.14	23756	14.70	135979	84.16	161570	100.00	7.23
Unknown	7	4.05	37	21.39	129	74.57	173	100.00	0.01
TOTAL	**31590**	**1.41**	**288730**	**12.93**	**1912968**	**85.66**	**2233288**	**100.00**	**100.00**

CASUALTY - OBJECT HIT OFF CARRIAGEWAY (2.14)

			Car	%age	Motorbike	%age	Other	%age	Total	%age
None	0	Fatal	14,851	1.05	3,249	1.86	4,423	1.38	22,523	1.17
		Serious	147,260	10.36	40,812	23.31	41,907	13.06	229,979	12.00
		Slight	1,258,974	88.59	131,032	74.84	274,558	85.56	1,664,564	86.83
		Total	1,421,085		175,093		320,888		1,917,066	85.84
Road sign/Traffic Signal	1	Fatal	497	1.93	178	11.95	59	1.94	734	2.43
		Serious	3,926	15.25	687	46.11	512	16.87	5,125	16.93
		Slight	21,319	82.82	625	41.95	2,464	81.19	24,408	80.64
		Total	25,742		1,490		3,035		30,267	1.36
Lamp Post	2	Fatal	688	2.32	183	20.58	54	1.85	925	2.76
		Serious	5,741	19.34	398	44.77	503	17.20	6,642	19.82
		Slight	23,262	78.35	308	34.65	2,367	80.95	25,937	77.41
		Total	29,691		889		2,924		33,504	1.50
Telegraph/Electricity Pole	3	Fatal	184	2.84	33	16.84	16	2.11	233	3.13
		Serious	1,270	19.57	107	54.59	150	19.82	1,527	20.52
		Slight	5,036	77.60	56	28.57	591	78.07	5,683	76.35
		Total	6,490		196		757		7,443	0.33
Tree	4	Fatal	1,827	5.40	130	28.95	133	3.85	2,090	5.48
		Serious	8,195	24.23	449	50.28	674	19.50	9,318	24.42
		Slight	23,793	70.36	314	35.16	2,650	76.66	26,757	70.11
		Total	33,815		893		3,457		38,165	1.71
Bus Stop/Shelter	5	Fatal	47	2.83	16	17.58	10	2.39	73	3.36
		Serious	328	19.74	37	40.66	49	11.72	414	19.07
		Slight	1,287	77.44	38	41.76	359	85.89	1,684	77.57
		Total	1,662		91		418		2,171	0.10
Central Crash Barrier	6	Fatal	436	1.37	158	13.37	123	2.61	717	1.90
		Serious	3,410	10.69	528	44.67	792	16.82	4,730	12.52
		Slight	28,042	87.94	496	41.96	3,793	80.56	32,331	85.58
		Total	31,888		1,182		4,708		37,778	1.69
Nearside or Offside Crash	7	Fatal	485	1.68	121	8.79	174	3.39	780	2.20
		Serious	3,832	13.25	627	45.53	1,010	19.69	5,469	15.44
		Slight	24,601	85.07	629	45.68	3,945	76.92	29,175	82.36
		Total	28,918		1,377		5,129		35,424	1.59
Submerged in Water (Com	8	Fatal	27	10.59	1	7.69	3	8.57	31	10.23
		Serious	51	20.00	9	69.23	9	25.71	69	22.77
		Slight	177	69.41	3	23.08	23	65.71	203	67.00
		Total	255		13		35		303	0.01
Entered Ditch	9	Fatal	536	2.23	81	6.49	107	2.99	724	2.51
		Serious	4,210	17.55	588	47.12	685	19.17	5,483	19.03
		Slight	19,242	80.22	579	46.39	2,782	77.84	22,603	78.46
		Total	23,988		1,248		3,574		28,810	1.29
Other Permanent Object	10	Fatal	2,132	2.48	374	7.37	229	2.18	2,735	2.70
		Serious	15,635	18.21	2,276	44.87	1,952	18.61	19,863	19.59
		Slight	68,082	79.30	2,422	47.75	8,308	79.21	78,812	77.72
		Total	85,849		5,072		10,489		101,410	4.54
Unknown		Fatal	10	1.66	5	7.25	10	3.61	25	2.64
		Serious	50	8.32	15	21.74	46	16.61	111	11.72
		Slight	541	90.02	49	71.01	221	79.78	811	85.64
		Total	601		69		277		947	0.04
TOTAL		Fatal	21,720	1.29	4,529	2.41	5,341	1.50	31,590	1.41
		Serious	193,908	11.47	46,533	24.80	48,289	13.58	288,730	12.93
		Slight	1,474,356	87.24	136,551	72.78	302,061	84.92	1,912,968	85.66

CASUALTIES PER YEAR - SCOTLAND ONLY

Year	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
1992	0	0.00	7	8.43	1	1.61	8	4.60
1993	2	6.90	2	2.41	3	4.84	7	4.02
1994	2	6.90	6	7.23	1	1.61	9	5.17
1995	1	3.45	4	4.82	6	9.68	11	6.32
1996	1	3.45	5	6.02	3	4.84	9	5.17
1997	1	3.45	2	2.41	5	8.06	8	4.60
1998	0	0.00	6	7.23	6	9.68	12	6.90
1999	2	6.90	6	7.23	4	6.45	12	6.90
2000	2	6.90	7	8.43	7	11.29	16	9.20
2001	4	13.79	6	7.23	9	14.52	19	10.92
2002	6	20.69	12	14.46	3	4.84	21	12.07
2003	2	6.90	7	8.43	3	4.84	12	6.90
2004	3	10.34	4	4.82	6	9.68	13	7.47
2005	3	10.34	9	10.84	5	8.06	17	9.77
Total	29	100.00	83	100.00	62	100.00	174	100.00

C.5 Median Barrier Impacts

CASUALTY - ROAD SPEED LIMIT (1.15)

Speed Limit (mph)	Fatal	%age	Serious	%age	Slight	%age	Total	%age
20	0	0.00	0	0.00	0	0.00	0	0.00
30	2	1.27	44	8.33	70	14.11	116	9.81
40	13	8.23	67	12.69	50	10.08	130	11.00
50	20	12.66	30	5.68	33	6.65	83	7.02
60	7	4.43	29	5.49	36	7.26	72	6.09
70	116	73.42	358	67.80	307	61.90	781	66.07
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - SEX (2.21)

Sex	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Male	149	94.30	482	91.29	443	89.31	1074	90.86
Female	9	5.70	46	8.71	53	10.69	108	9.14
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - OBJECT HIT IN CARRIAGEWAY (2.12)

Object Hit	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
None	125	79.11	421	79.73	395	79.64	941	79.61
Previous Accident	0	0.00	0	0.00	0	0.00	0	0.00
Road works	1	0.63	1	0.19	2	0.40	4	0.34
Parked Vehicle	1	0.63	0	0.00	1	0.20	2	0.17
Bridge - roof	0	0.00	0	0.00	0	0.00	0	0.00
Bridge - side	0	0.00	0	0.00	0	0.00	0	0.00
Bollard/Refuge	3	1.90	6	1.14	11	2.22	20	1.69
Open door of vehicle	0	0.00	0	0.00	1	0.20	1	0.08
Central island of roundabout	0	0.00	2	0.38	1	0.20	3	0.25
Kerb	27	17.09	85	16.10	76	15.32	188	15.91
Other	1	0.63	13	2.46	9	1.81	23	1.95
Animal (except riden horses)	0	0.00	0	0.00	0	0.00	0	0.00
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - LIGHT CONDITIONS (1.21)

Lighting Condition	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Daylight - street lights present	72	45.57	275	52.08	268	54.03	615	52.03
Daylight - no street lights present	35	22.15	136	25.76	115	23.19	286	24.20
Daylight - street lights unknown	6	3.80	12	2.27	21	4.23	39	3.30
Darkness - street lights present and lit	20	12.66	60	11.36	58	11.69	138	11.68
Darkness - street lights present and not lit	7	4.43	5	0.95	9	1.81	21	1.78
Darkness - no street lights present	17	10.76	34	6.44	22	4.44	73	6.18
Darkness - street lights unknown	1	0.63	6	1.14	3	0.60	10	0.85
Not reported	0	0.00	0	0.00	0	0.00	0	0.00
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - WEATHER CONDITIONS (1.22)

Weather Condition	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Fine without high winds	150	94.94	475	89.96	424	85.48	1049	88.75
Raining without high winds	5	3.16	26	4.92	43	8.67	74	6.26
Snowing without high winds	0	0.00	0	0.00	1	0.20	1	0.08
Fine with high winds	1	0.63	15	2.84	11	2.22	27	2.28
Raining with high winds	2	1.27	4	0.76	6	1.21	12	1.02
Snowing with high winds	0	0.00	0	0.00	0	0.00	0	0.00
Fog or mist - if hazard	0	0.00	2	0.38	3	0.60	5	0.42
Other	0	0.00	5	0.95	7	1.41	12	1.02
Unknown	0	0.00	1	0.19	1	0.20	2	0.17
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - ROAD SURFACE (1.23)

Road Surface	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Dry	134	84.81	441	83.52	396	79.84	971	82.15
Wet/Damp	22	13.92	80	15.15	92	18.55	194	16.41
Snow	0	0.00	1	0.19	1	0.20	2	0.17
Frost/Ice	1	0.63	3	0.57	4	0.81	8	0.68
Flood (surface water over 3cm deep)	0	0.00	1	0.19	0	0.00	1	0.08
Not reported	1	0.63	2	0.38	3	0.60	6	0.51
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - ROAD CLASS (1.12)

Road Class	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Motorway	49	31.01	131	24.81	132	26.61	312	26.40
A(M)	0	0.00	12	2.27	8	1.61	20	1.69
A	109	68.99	385	72.92	356	71.77	850	71.91
B	0	0.00	0	0.00	0	0.00	0	0.00
C	0	0.00	0	0.00	0	0.00	0	0.00
Unclassified	0	0.00	0	0.00	0	0.00	0	0.00
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - CARRIAGEWAY TYPE (1.14)

Road Class	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Roundabout	0	0.00	12	2.27	16	3.23	28	2.37
One way street	0	0.00	1	0.19	5	1.01	6	0.51
Dual Carriageway	157	99.37	511	96.78	474	95.56	1142	96.62
Single Carriageway	1	0.63	4	0.76	1	0.20	6	0.51
Unknown	0	0.00	0	0.00	0	0.00	0	0.00
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - COUNTRY

Country	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
England	147	93.04	485	91.86	465	93.75	1097	92.81
Scotland	8	5.06	19	3.60	11	2.22	38	3.21
Wales	3	1.90	24	4.55	20	4.03	47	3.98
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - AGE

Age	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
<18	1	0.63	12	2.27	22	4.44	35	2.96
18-25	31	19.62	137	25.95	126	25.40	294	24.87
26-35	66	41.77	204	38.64	178	35.89	448	37.90
36-45	34	21.52	111	21.02	98	19.76	243	20.56
46-55	18	11.39	39	7.39	50	10.08	107	9.05
56-65	5	3.16	14	2.65	13	2.62	32	2.71
65+	2	1.27	1	0.19	0	0.00	3	0.25
Not reported	1	0.63	10	1.89	9	1.81	20	1.69
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - VEHICLE TYPE

Vehicle Type	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Motor scooter	5	3.16	25	4.73	41	8.27	71	6.01
Motorcycle	134	84.81	462	87.50	414	83.47	1010	85.45
Combination	19	12.03	41	7.77	41	8.27	101	8.54
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - YEAR

Year	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
1992	6	3.80	21	3.98	23	4.64	50	4.23
1993	6	3.80	29	5.49	20	4.03	55	4.65
1994	7	4.43	30	5.68	22	4.44	59	4.99
1995	12	7.59	30	5.68	45	9.07	87	7.36
1996	4	2.53	28	5.30	34	6.85	66	5.58
1997	12	7.59	36	6.82	36	7.26	84	7.11
1998	8	5.06	23	4.36	35	7.06	66	5.58
1999	12	7.59	47	8.90	37	7.46	96	8.12
2000	15	9.49	54	10.23	40	8.06	109	9.22
2001	17	10.76	46	8.71	35	7.06	98	8.29
2002	9	5.70	43	8.14	39	7.86	91	7.70
2003	19	12.03	48	9.09	42	8.47	109	9.22
2004	12	7.59	41	7.77	39	7.86	92	7.78
2005	19	12.03	52	9.85	49	9.88	120	10.15
Total	158	100.00	528	100.00	496	100.00	1182	100.00

CASUALTY - AGE

Age	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
<20	2	1.27	42	7.95	41	8.27	85	7.19
20-29	55	34.81	196	37.12	174	35.08	425	35.96
30-39	63	39.87	179	33.90	164	33.06	406	34.35
40-49	23	14.56	72	13.64	67	13.51	162	13.71
50-59	9	5.70	25	4.73	36	7.26	70	5.92
60+	5	3.16	4	0.76	5	1.01	14	1.18
Not reported	1	0.63	10	1.89	9	1.81	20	1.69
Total	158	100.00	528	100.00	496	100.00	1182	100.00

C.6 Verge Barrier Impacts

CASUALTY - ROAD SPEED LIMIT (1.15)

Speed Limit (mph)	Fatal	%age	Serious	%age	Slight	%age	Total	%age
20	0	0.00	1	0.16	0	0.00	1	0.07
30	11	9.09	85	13.56	122	19.40	218	15.83
40	7	5.79	46	7.34	62	9.86	115	8.35
50	11	9.09	30	4.78	41	6.52	82	5.95
60	48	39.67	268	42.74	183	29.09	499	36.24
70	44	36.36	197	31.42	221	35.14	462	33.55
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - SEX (2.21)

Sex	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Male	109	90.08	568	90.59	553	87.92	1230	89.32
Female	12	9.92	59	9.41	76	12.08	147	10.68
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - OBJECT HIT IN CARRIAGEWAY (2.12)

Object Hit	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
None	92	76.03	509	81.18	493	78.38	1094	79.45
Previous Accident	0	0.00	0	0.00	0	0.00	0	0.00
Road works	0	0.00	0	0.00	0	0.00	0	0.00
Parked Vehicle	1	0.83	1	0.16	2	0.32	4	0.29
Bridge - roof	0	0.00	0	0.00	0	0.00	0	0.00
Bridge - side	1	0.83	0	0.00	1	0.16	2	0.15
Bollard/Refuge	1	0.83	7	1.12	10	1.59	18	1.31
Open door of vehicle	1	0.83	0	0.00	0	0.00	1	0.07
Central island of roundabout	0	0.00	5	0.80	6	0.95	11	0.80
Kerb	21	17.36	98	15.63	109	17.33	228	16.56
Other	4	3.31	7	1.12	8	1.27	19	1.38
Animal (except riden horses)	0	0.00	0	0.00	0	0.00	0	0.00
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - LIGHT CONDITIONS (1.21)

Lighting Condition	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Daylight - street lights present	44	36.36	232	37.00	299	47.54	575	41.76
Daylight - no street lights present	46	38.02	238	37.96	172	27.34	456	33.12
Daylight - street lights unknown	0	0.00	29	4.63	34	5.41	63	4.58
Darkness - street lights present and lit	13	10.74	74	11.80	86	13.67	173	12.56
Darkness - street lights present and not lit	4	3.31	23	3.67	13	2.07	40	2.90
Darkness - no street lights present	11	9.09	23	3.67	20	3.18	54	3.92
Darkness - street lights unknown	3	2.48	8	1.28	3	0.48	14	1.02
Not reported	0	0.00	0	0.00	2	0.32	2	0.15
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - WEATHER CONDITIONS (1.22)

Weather Condition	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Fine without high winds	109	90.08	565	90.11	559	88.87	1233	89.54
Raining without high winds	9	7.44	30	4.78	46	7.31	85	6.17
Snowing without high winds	0	0.00	0	0.00	1	0.16	1	0.07
Fine with high winds	1	0.83	21	3.35	10	1.59	32	2.32
Raining with high winds	0	0.00	3	0.48	3	0.48	6	0.44
Snowing with high winds	0	0.00	0	0.00	0	0.00	0	0.00
Fog or mist - if hazard	1	0.83	2	0.32	3	0.48	6	0.44
Other	0	0.00	6	0.96	6	0.95	12	0.87
Unknown	1	0.83	0	0.00	1	0.16	2	0.15
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - ROAD SURFACE (1.23)

Road Surface	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Dry	105	86.78	521	83.09	503	79.97	1129	81.99
Wet/Damp	15	12.40	103	16.43	117	18.60	235	17.07
Snow	0	0.00	0	0.00	1	0.16	1	0.07
Frost/Ice	1	0.83	1	0.16	3	0.48	5	0.36
Flood (surface water over 3cm deep)	0	0.00	0	0.00	0	0.00	0	0.00
Not reported	0	0.00	2	0.32	5	0.79	7	0.51
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - ROAD CLASS (1.12)

Road Class	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Motorway	21	17.36	100	15.95	123	19.55	244	17.72
A(M)	3	2.48	10	1.59	14	2.23	27	1.96
A	97	80.17	517	82.46	492	78.22	1106	80.32
B	0	0.00	0	0.00	0	0.00	0	0.00
C	0	0.00	0	0.00	0	0.00	0	0.00
Unclassified	0	0.00	0	0.00	0	0.00	0	0.00
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - CARRIAGEWAY TYPE (1.14)

Road Class	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Roundabout	11	9.09	72	11.48	86	13.67	169	12.27
One way street	4	3.31	51	8.13	54	8.59	109	7.92
Dual Carriageway	54	44.63	210	33.49	242	38.47	506	36.75
Single Carriageway	50	41.32	294	46.89	246	39.11	590	42.85
Unknown	2	1.65	0	0.00	1	0.16	3	0.22
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - COUNTRY

Country	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
England	92	76.03	476	75.92	529	84.10	1097	79.67
Scotland	21	17.36	64	10.21	51	8.11	136	9.88
Wales	8	6.61	87	13.88	49	7.79	144	10.46
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - AGE

Age	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
<18	3	2.48	17	2.71	24	3.82	44	3.20
18-25	25	20.66	174	27.75	171	27.19	370	26.87
26-35	39	32.23	222	35.41	230	36.57	491	35.66
36-45	34	28.10	147	23.44	143	22.73	324	23.53
46-55	13	10.74	47	7.50	41	6.52	101	7.33
56-65	6	4.96	13	2.07	7	1.11	26	1.89
65+	0	0.00	5	0.80	7	1.11	12	0.87
Not reported	1	0.83	2	0.32	6	0.95	9	0.65
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - VEHICLE TYPE

Vehicle Type	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
Motor scooter	6	4.96	54	8.61	56	8.90	116	8.42
Motorcycle	110	90.91	533	85.01	524	83.31	1167	84.75
Combination	5	4.13	40	6.38	49	7.79	94	6.83
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - YEAR

Year	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
1992	7	5.79	29	4.63	33	5.25	69	5.01
1993	3	2.48	28	4.47	27	4.29	58	4.21
1994	8	6.61	32	5.10	28	4.45	68	4.94
1995	2	1.65	28	4.47	36	5.72	66	4.79
1996	8	6.61	42	6.70	41	6.52	91	6.61
1997	7	5.79	32	5.10	52	8.27	91	6.61
1998	7	5.79	51	8.13	35	5.56	93	6.75
1999	8	6.61	57	9.09	54	8.59	119	8.64
2000	12	9.92	56	8.93	49	7.79	117	8.50
2001	7	5.79	49	7.81	52	8.27	108	7.84
2002	21	17.36	62	9.89	61	9.70	144	10.46
2003	14	11.57	50	7.97	52	8.27	116	8.42
2004	9	7.44	56	8.93	40	6.36	105	7.63
2005	8	6.61	55	8.77	69	10.97	132	9.59
Total	121	100.00	627	100.00	629	100.00	1377	100.00

CASUALTY - AGE

Age	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
<20	6	4.96	46	7.34	65	10.33	117	8.50
20-29	39	32.23	237	37.80	230	36.57	506	36.75
30-39	38	31.40	211	33.65	204	32.43	453	32.90
40-49	21	17.36	87	13.88	87	13.83	195	14.16
50-59	14	11.57	35	5.58	30	4.77	79	5.74
60+	2	1.65	9	1.44	7	1.11	18	1.31
Not reported	1	0.83	2	0.32	6	0.95	9	0.65
Total	121	100.00	627	100.00	629	100.00	1377	100.00

C.7 All Barrier Impacts

CASUALTY - ROAD SPEED LIMIT (1.15)

Speed Limit (mph)	Fatal	%age	Serious	%age	Slight	%age	Total	%age
20	0	0.00	1	0.08	0	0.00	1	0.04
30	13	5.18	129	10.94	192	16.75	334	12.82
40	20	7.01	113	10.01	112	9.97	245	9.67
50	31	10.87	60	5.23	74	6.59	165	6.49
60	55	22.05	297	24.12	219	18.18	571	21.16
70	160	54.89	555	49.61	528	48.52	1243	49.81
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - SEX (2.21)

Sex	Fatal	%age	Serious	%age	Slight	%age	Total	%age
Male	258	92.19	1050	90.94	996	88.62	2304	90.09
Female	21	7.81	105	9.06	129	11.38	255	9.91
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - OBJECT HIT IN CARRIAGEWAY (2.12)

Object Hit	Fatal	%age	Serious	%age	Slight	%age	Total	%age
None	217	77.57	930	80.46	888	79.01	2035	79.53
Previous Accident	0	0.00	0	0.00	0	0.00	0	0.00
Road works	1	0.32	1	0.09	2	0.20	4	0.17
Parked Vehicle	2	0.73	1	0.08	3	0.26	6	0.23
Bridge - roof	0	0.00	0	0.00	0	0.00	0	0.00
Bridge - side	1	0.41	0	0.00	1	0.08	2	0.07
Bollard/Refuge	4	1.36	13	1.13	21	1.90	38	1.50
Open door of vehicle	1	0.41	0	0.00	1	0.10	2	0.08
Central island of roundabout	0	0.00	7	0.59	7	0.58	14	0.53
Kerb	48	17.22	183	15.86	185	16.33	416	16.23
Other	5	1.97	20	1.79	17	1.54	42	1.66
Animal (except riden horses)	0	0.00	0	0.00	0	0.00	0	0.00
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - LIGHT CONDITIONS (1.21)

Lighting Condition	Fatal	%age	Serious	%age	Slight	%age	Total	%age
Daylight - street lights present	116	40.97	507	44.54	567	50.78	1190	46.89
Daylight - no street lights present	81	30.08	374	31.86	287	25.27	742	28.66
Daylight - street lights unknown	6	1.90	41	3.45	55	4.82	102	3.94
Darkness - street lights present and lit	33	11.70	134	11.58	144	12.68	311	12.12
Darkness - street lights present and not lit	11	3.87	28	2.31	22	1.94	61	2.34
Darkness - no street lights present	28	9.93	57	5.05	42	3.81	127	5.05
Darkness - street lights unknown	4	1.56	14	1.21	6	0.54	24	0.93
Not reported	0	0.00	0	0.00	2	0.16	2	0.07
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - WEATHER CONDITIONS (1.22)

Weather Condition	Fatal	%age	Serious	%age	Slight	%age	Total	%age
Fine without high winds	259	92.51	1040	90.04	983	87.18	2282	89.15
Raining without high winds	14	5.30	56	4.85	89	7.99	159	6.22
Snowing without high winds	0	0.00	0	0.00	2	0.18	2	0.08
Fine with high winds	2	0.73	36	3.10	21	1.90	59	2.30
Raining with high winds	2	0.63	7	0.62	9	0.84	18	0.73
Snowing with high winds	0	0.00	0	0.00	0	0.00	0	0.00
Fog or mist - if hazard	1	0.41	4	0.35	6	0.54	11	0.43
Other	0	0.00	11	0.95	13	1.18	24	0.94
Unknown	1	0.41	1	0.09	2	0.18	4	0.16
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - ROAD SURFACE (1.23)

Road Surface	Fatal	%age	Serious	%age	Slight	%age	Total	%age
Dry	239	85.79	962	83.31	899	79.90	2100	82.07
Wet/Damp	37	13.16	183	15.79	209	18.57	429	16.74
Snow	0	0.00	1	0.09	2	0.18	3	0.12
Frost/Ice	2	0.73	4	0.36	7	0.64	13	0.52
Flood (surface water over 3cm deep)	0	0.00	1	0.09	0	0.00	1	0.04
Not reported	1	0.32	4	0.35	8	0.70	13	0.51
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - ROAD CLASS (1.12)

Road Class	Fatal	%age	Serious	%age	Slight	%age	Total	%age
Motorway	70	24.18	231	20.38	255	23.08	556	22.06
A(M)	3	1.24	22	1.93	22	1.92	47	1.83
A	206	74.58	902	77.69	848	75.00	1956	76.12
B	0	0.00	0	0.00	0	0.00	0	0.00
C	0	0.00	0	0.00	0	0.00	0	0.00
Unclassified	0	0.00	0	0.00	0	0.00	0	0.00
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - CARRIAGEWAY TYPE (1.14)

Road Class	Fatal	%age	Serious	%age	Slight	%age	Total	%age
Roundabout	11	4.55	84	6.88	102	8.45	197	7.32
One way street	4	1.65	52	4.16	59	4.80	115	4.21
Dual Carriageway	211	72.00	721	65.14	716	67.02	1648	66.68
Single Carriageway	51	20.98	298	23.82	247	19.66	596	21.68
Unknown	2	0.83	0	0.00	1	0.08	3	0.11
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - COUNTRY

Country	Fatal	%age	Serious	%age	Slight	%age	Total	%age
England	239	84.54	961	83.89	994	88.93	2194	86.24
Scotland	29	11.21	83	6.90	62	5.16	174	6.55
Wales	11	4.26	111	9.21	69	5.91	191	7.22
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - AGE

Age	Fatal	%age	Serious	%age	Slight	%age	Total	%age
<18	4	1.56	29	2.49	46	4.13	79	3.08
18-25	56	20.14	311	26.85	297	26.29	664	25.87
26-35	105	37.00	426	37.02	408	36.23	939	36.78
36-45	68	24.81	258	22.23	241	21.25	567	22.04
46-55	31	11.07	86	7.44	91	8.30	208	8.19
56-65	11	4.06	27	2.36	20	1.87	58	2.30
65+	2	0.63	6	0.49	7	0.56	15	0.56
Not reported	2	0.73	12	1.11	15	1.38	29	1.17
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - VEHICLE TYPE

Vehicle Type	Fatal	%age	Serious	%age	Slight	%age	Total	%age
Motor scooter	11	4.06	79	6.67	97	8.58	187	7.22
Motorcycle	244	87.86	995	86.25	938	83.39	2177	85.10
Combination	24	8.08	81	7.07	90	8.03	195	7.69
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - YEAR

Year	Fatal	%age	Serious	%age	Slight	%age	Total	%age
1992	13	4.79	50	4.30	56	4.94	119	4.62
1993	9	3.14	57	4.98	47	4.16	113	4.43
1994	15	5.52	62	5.39	50	4.44	127	4.96
1995	14	4.62	58	5.07	81	7.40	153	6.08
1996	12	4.57	70	6.00	75	6.69	157	6.10
1997	19	6.69	68	5.96	88	7.76	175	6.86
1998	15	5.42	74	6.25	70	6.31	159	6.17
1999	20	7.10	104	9.00	91	8.02	215	8.38
2000	27	9.71	110	9.58	89	7.93	226	8.86
2001	24	8.27	95	8.26	87	7.66	206	8.07
2002	30	11.53	105	9.02	100	8.78	235	9.08
2003	33	11.80	98	8.53	94	8.37	225	8.82
2004	21	7.52	97	8.35	79	7.11	197	7.70
2005	27	9.32	107	9.31	118	10.42	252	9.87
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

CASUALTY - AGE

Age	Fatal	%age	Serious	%age	Slight	%age	TOTAL	%age
<20	8	2.87	88	7.62	106	9.42	202	7.84
20-29	94	33.69	433	37.49	404	35.91	931	36.35
30-39	101	36.20	390	33.77	368	32.71	859	33.62
40-49	44	15.77	159	13.77	154	13.69	357	13.93
50-59	23	8.24	60	5.19	66	5.87	149	5.83
60+	7	2.51	13	1.13	12	1.07	32	1.25
Not reported	2	0.72	12	1.04	15	1.33	29	1.17
Total	279	100.00	1155	100.00	1125	100.00	2559	100.00

Appendix D STATS19 Graphs

Figure D1 Type of vehicle involved in all incidents (by number of casualties)

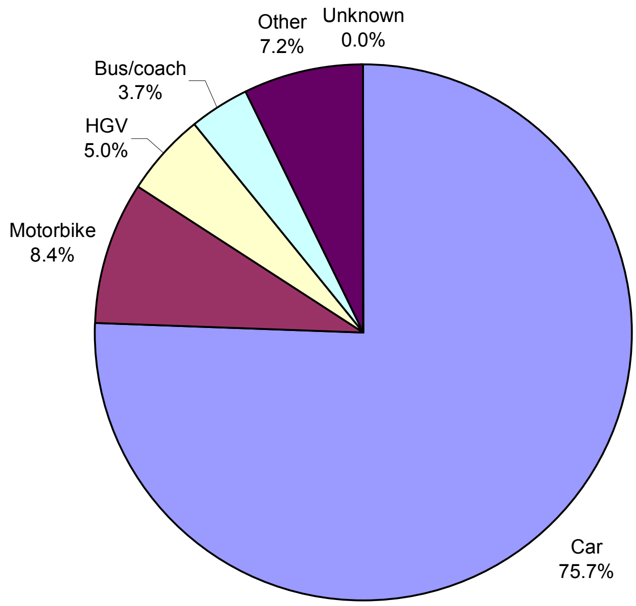


Figure D2 Severity of all accidents

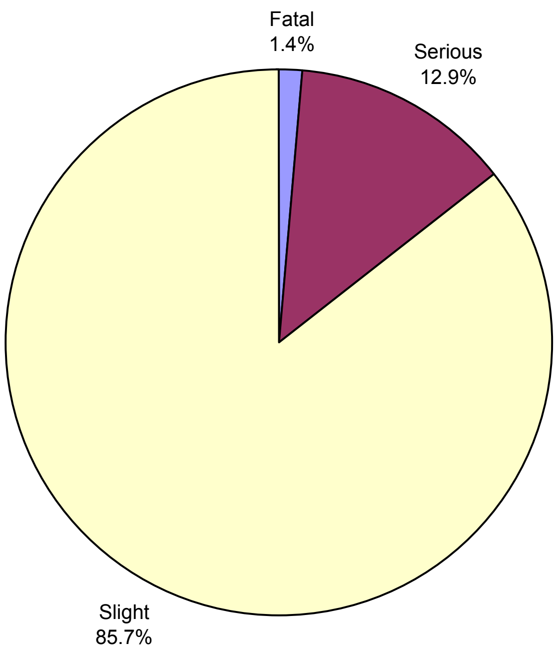


Figure D3 Severity of all accidents by vehicle involved

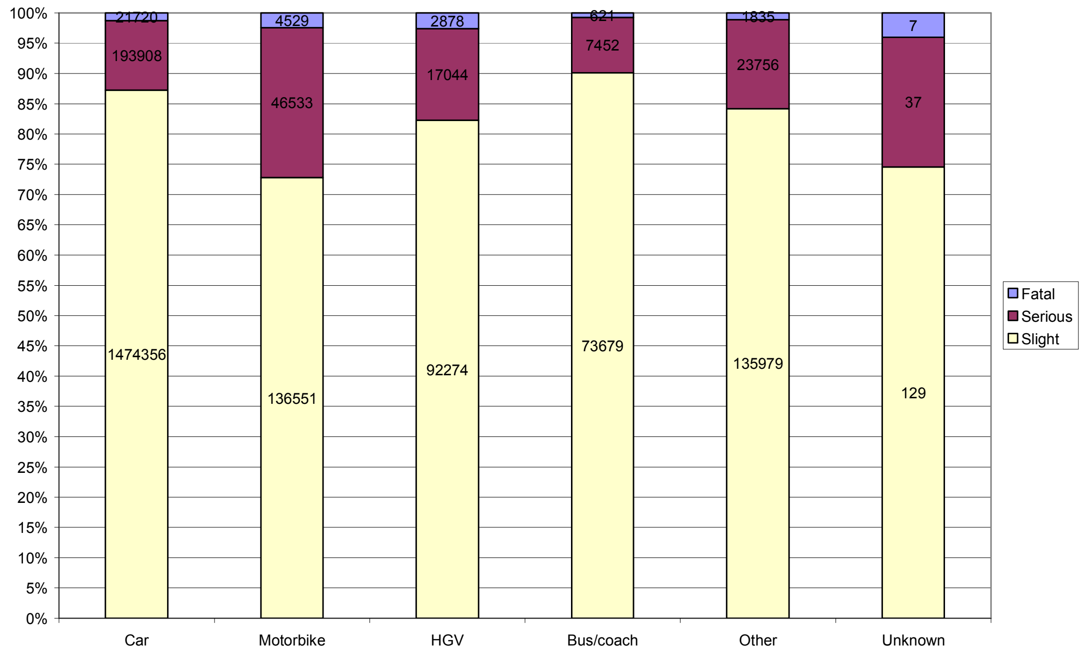


Figure D4 Car Impacts – object struck

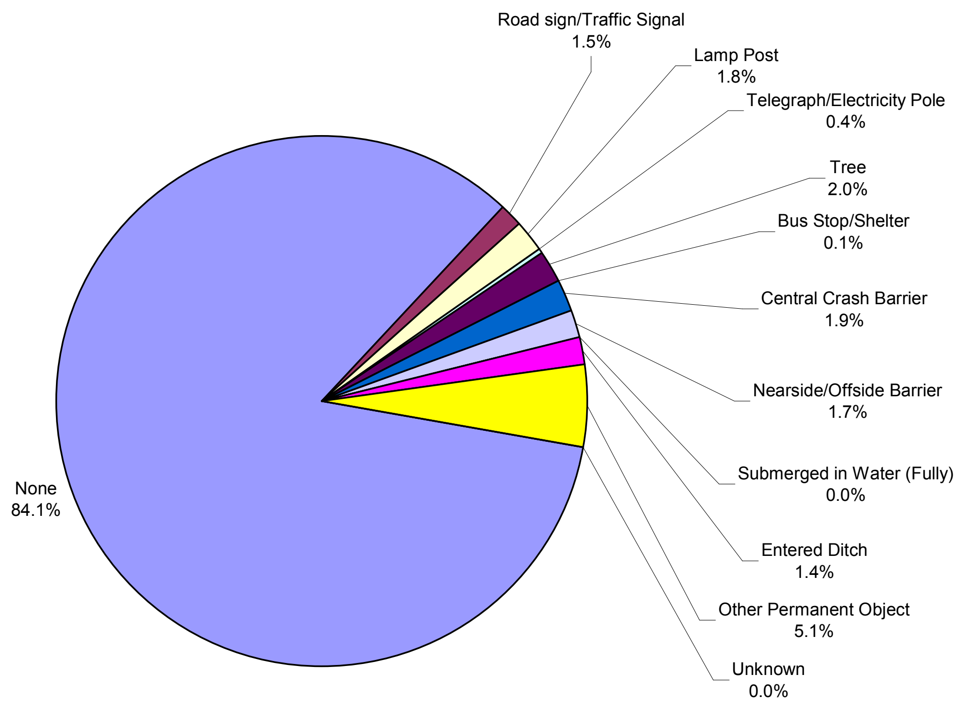


Figure D5 Motorbike Impacts – object struck

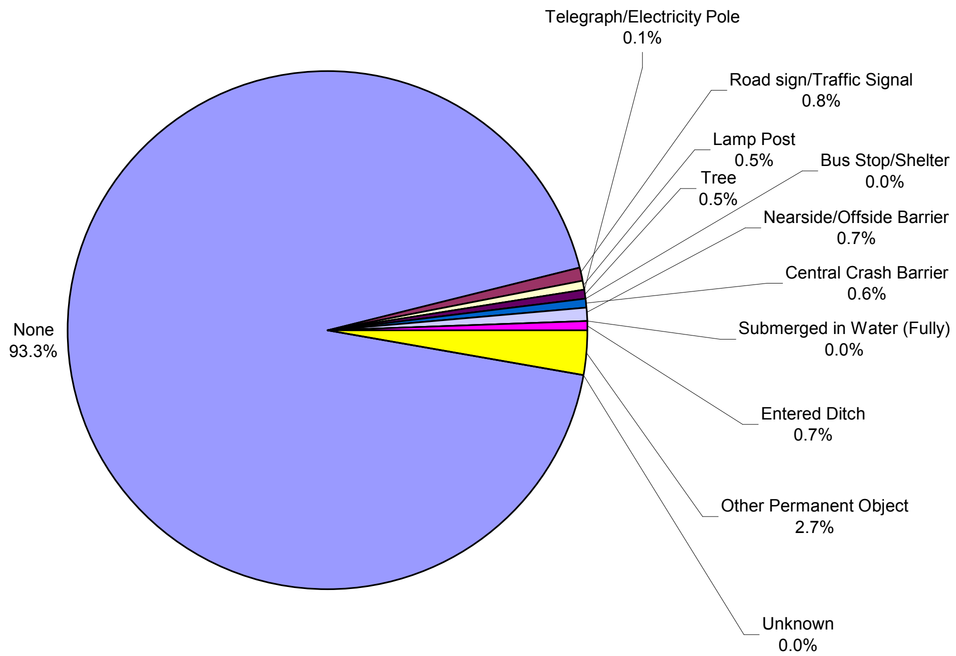


Figure D6 Other vehicles – object struck

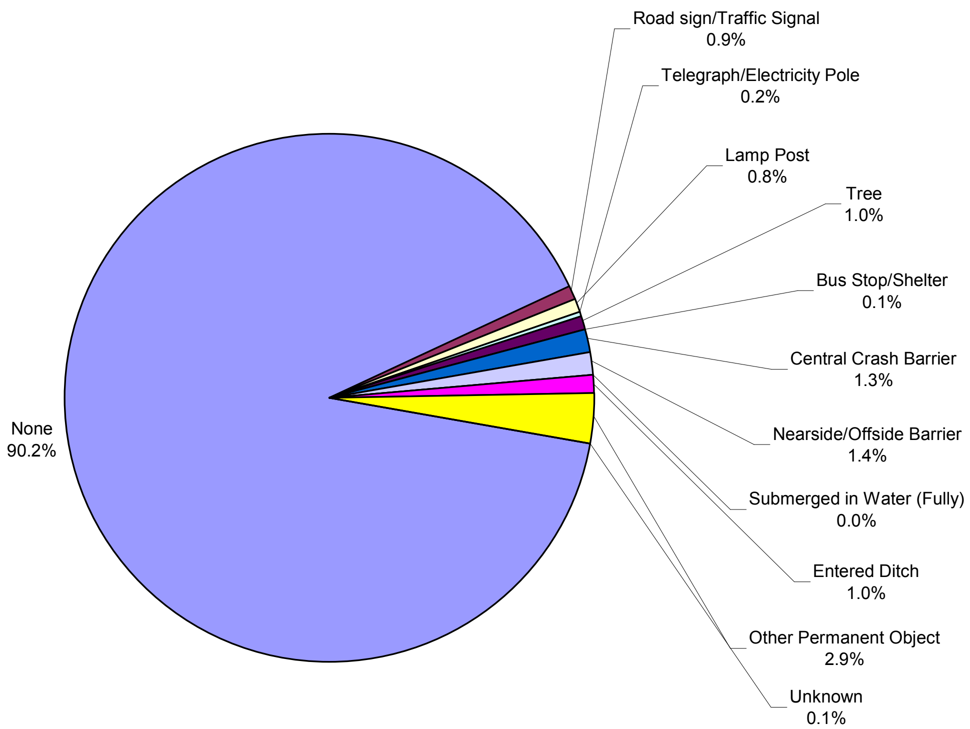


Figure D7 Car – severity of object hit

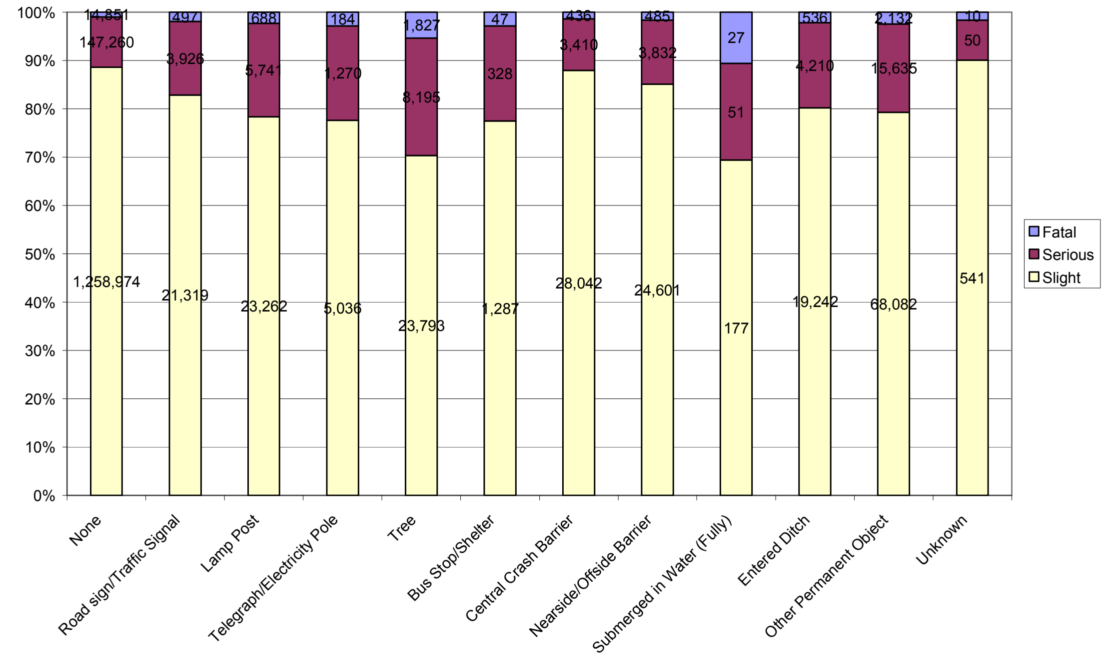


Figure D8 Motorbike – severity of object hit

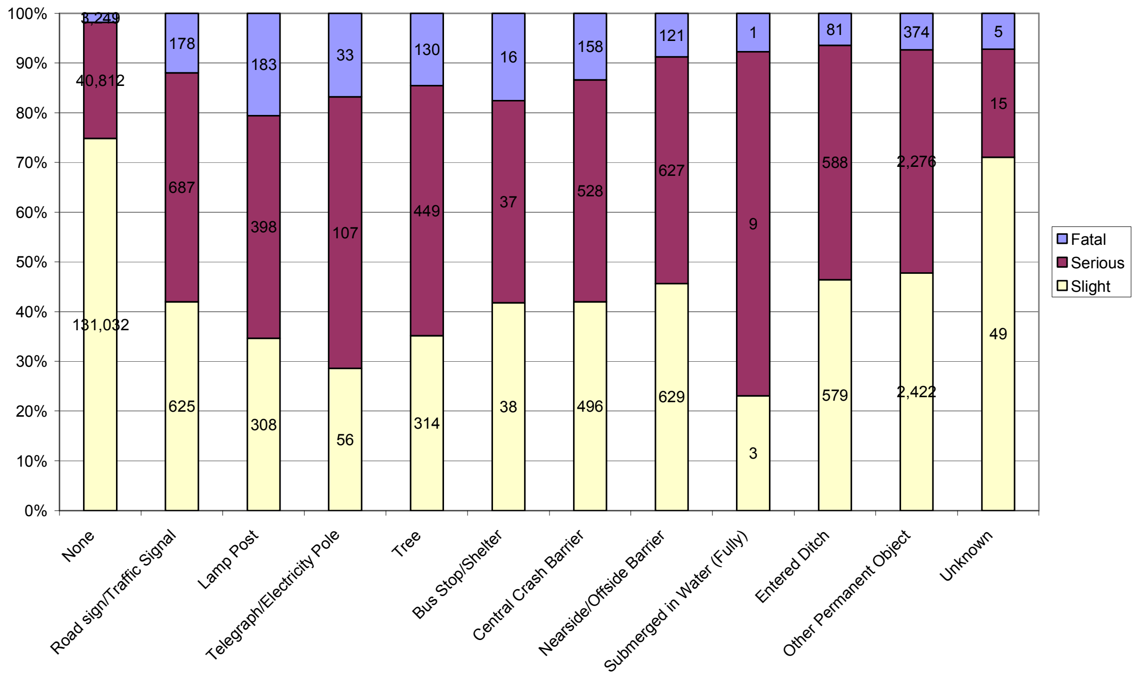


Figure D9 Other – severity of object hit

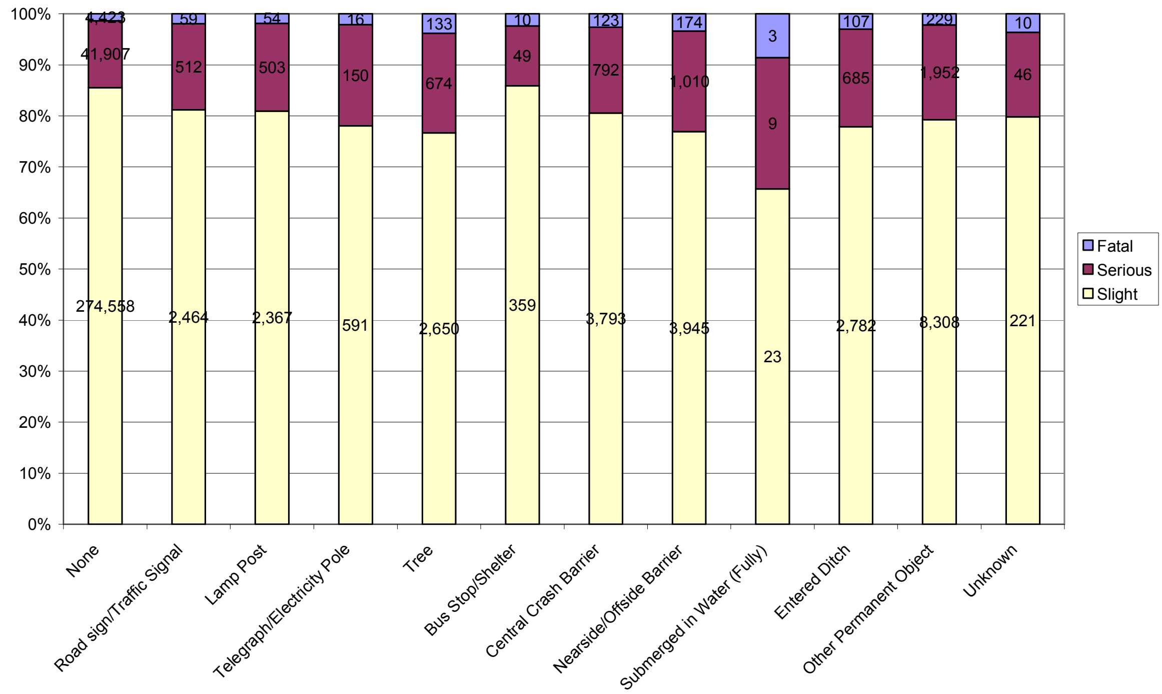


Figure D10 Severity of object hit – all vehicles

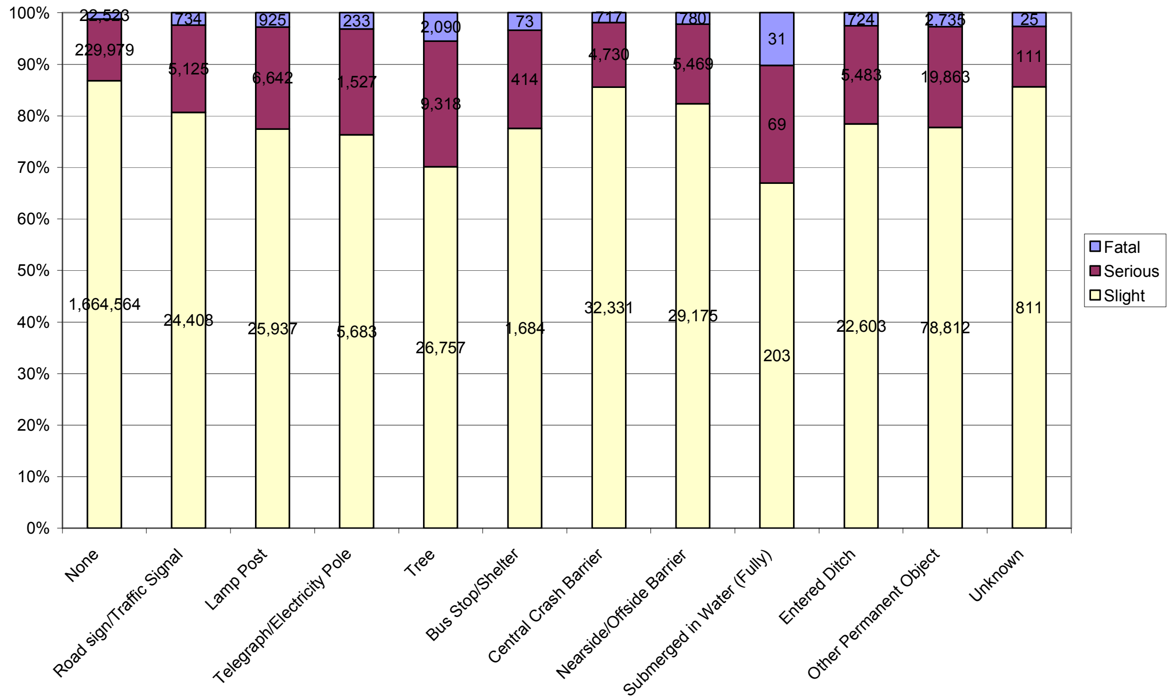


Figure D11 Severity of safety barrier impacts, by vehicle and barrier type

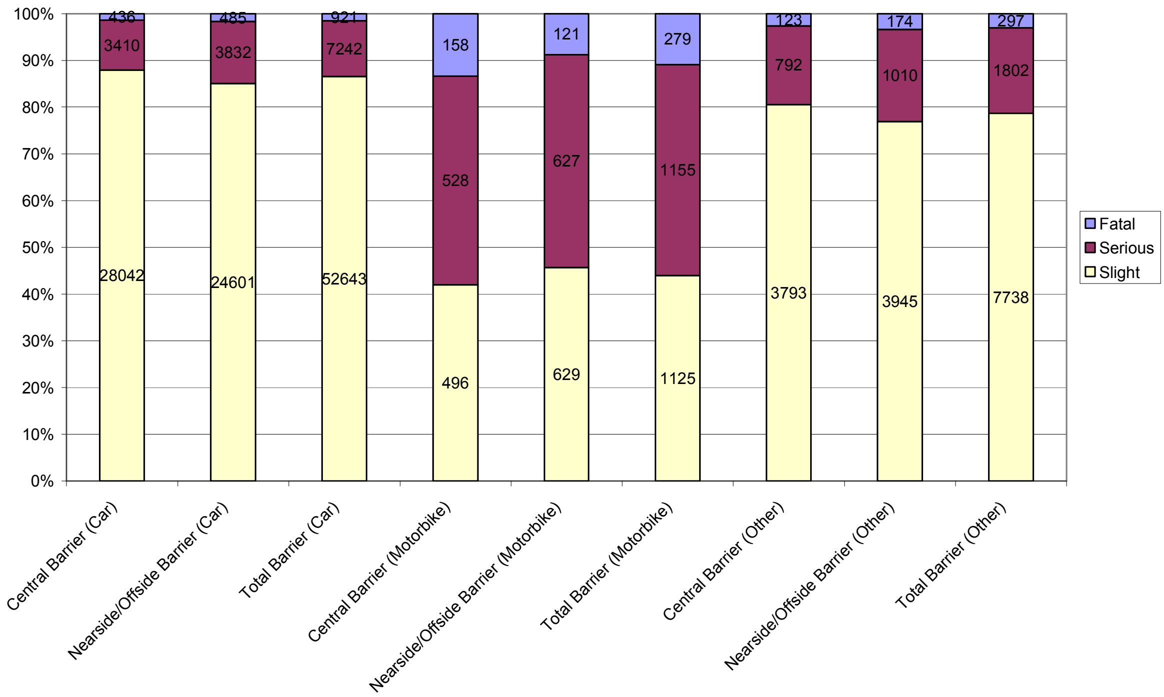


Figure D12 Number of motorcyclist to safety barrier accidents all countries, by year

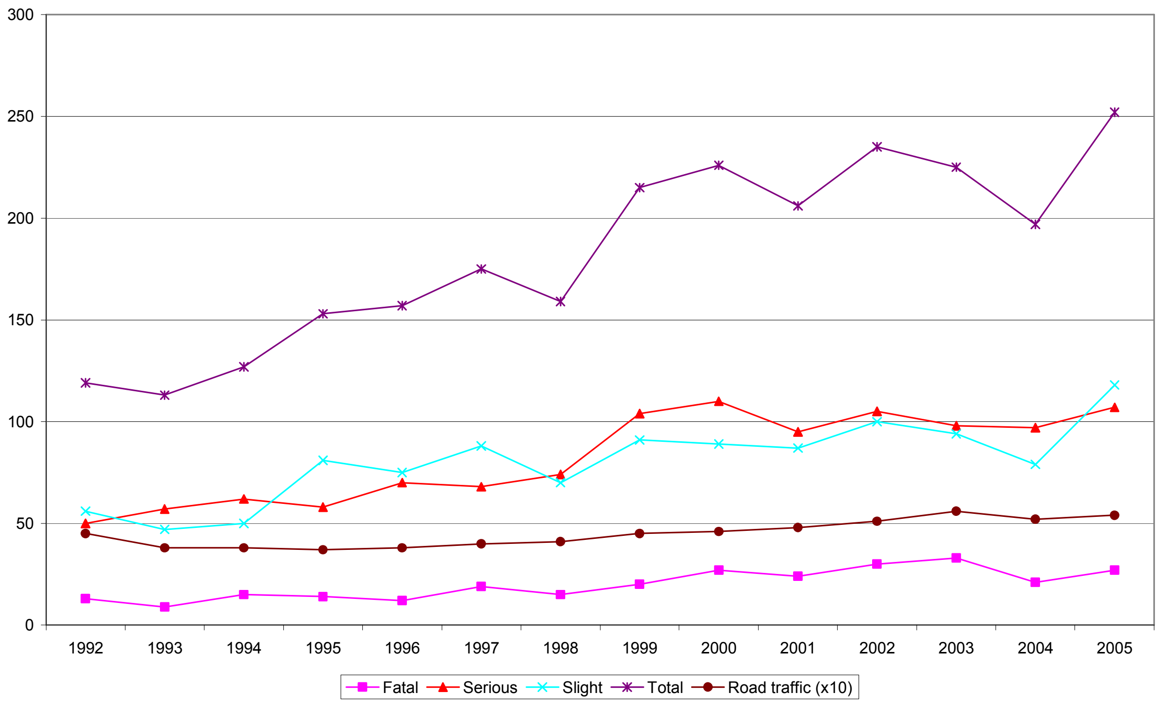


Figure D13 Number of motorcyclist to safety barrier accidents in Scotland, by year

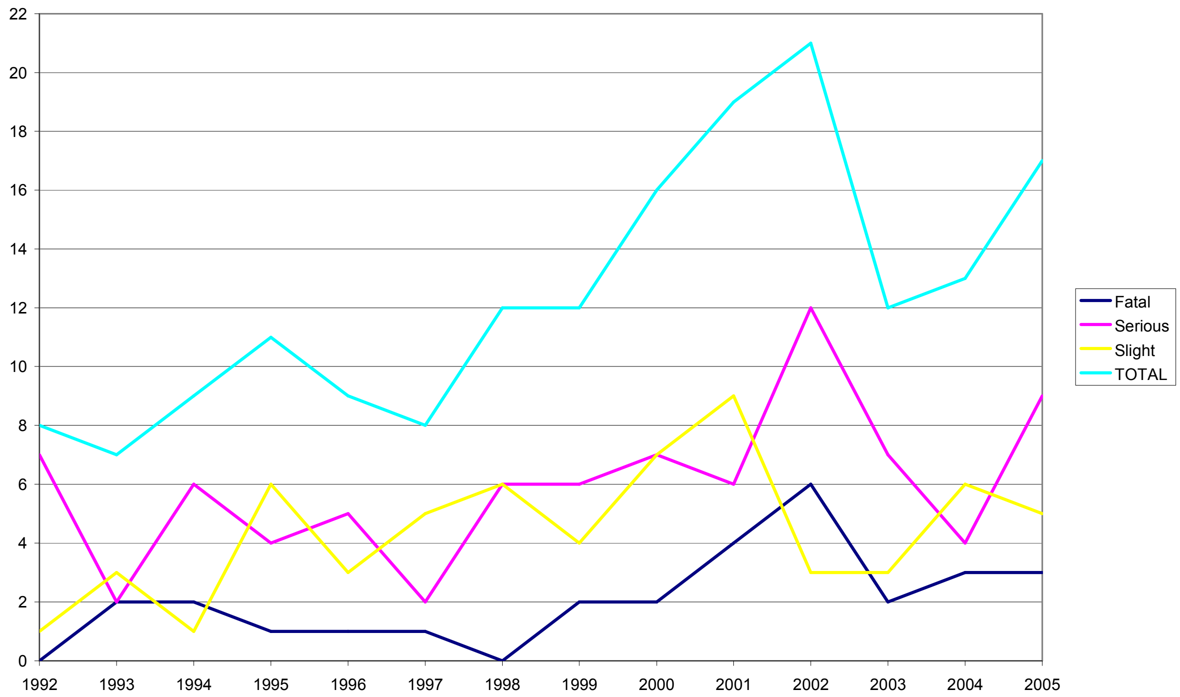


Figure D14 Median Barrier impacts – Speed Limit

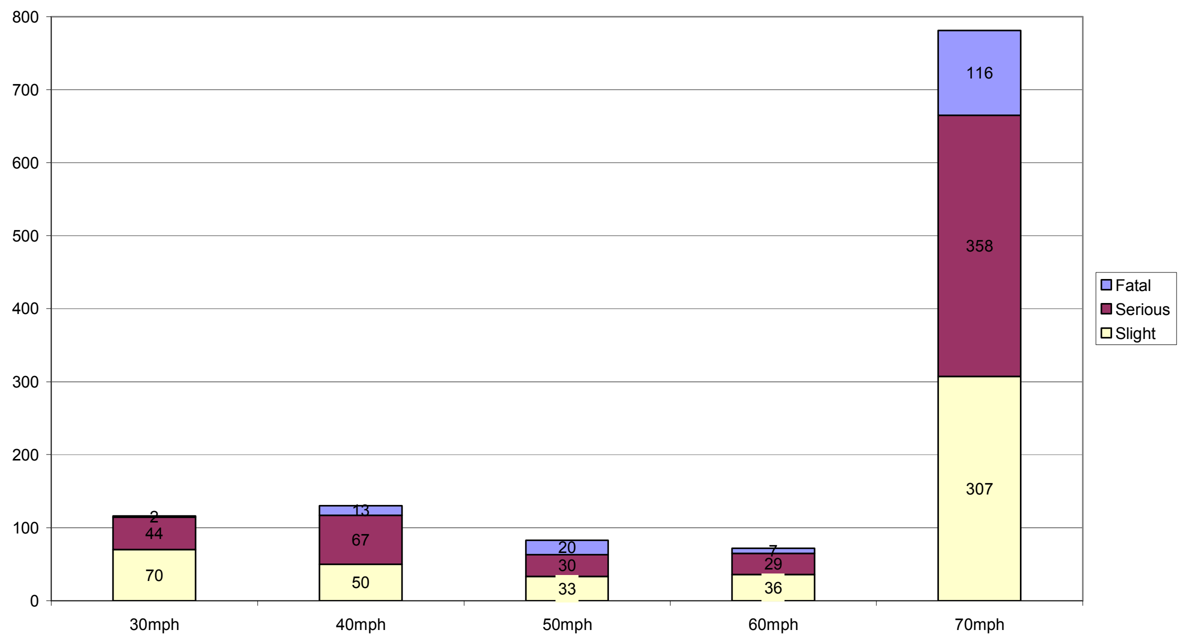


Figure D15 Verge Barrier impacts – Speed Limit

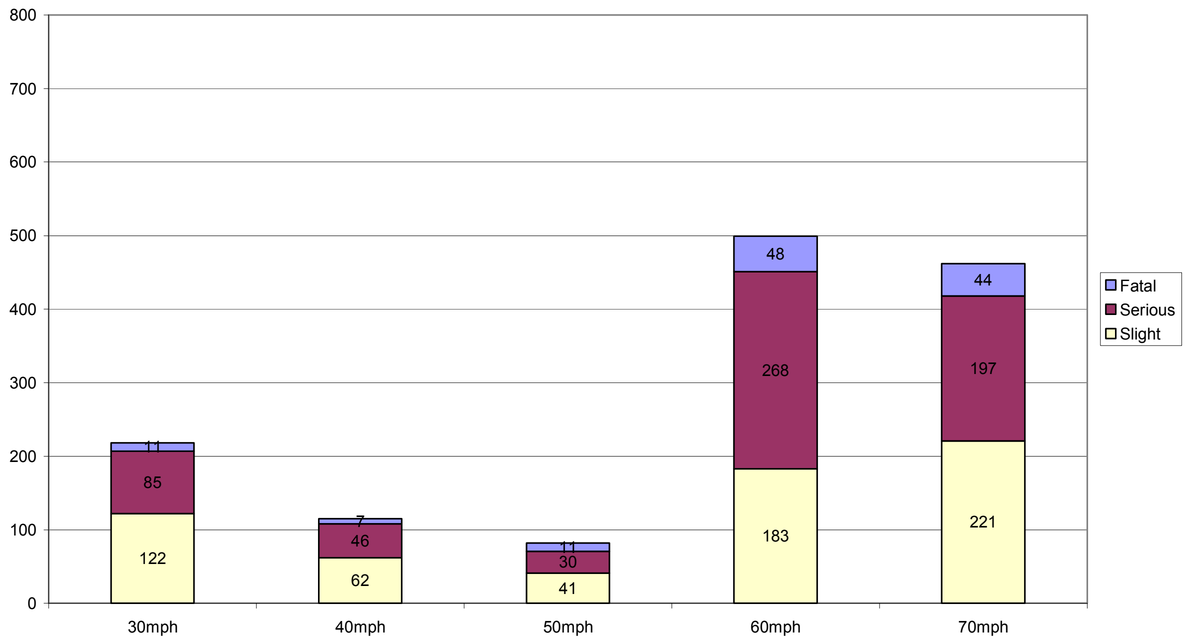


Figure D16 All Barrier impacts – Speed Limit

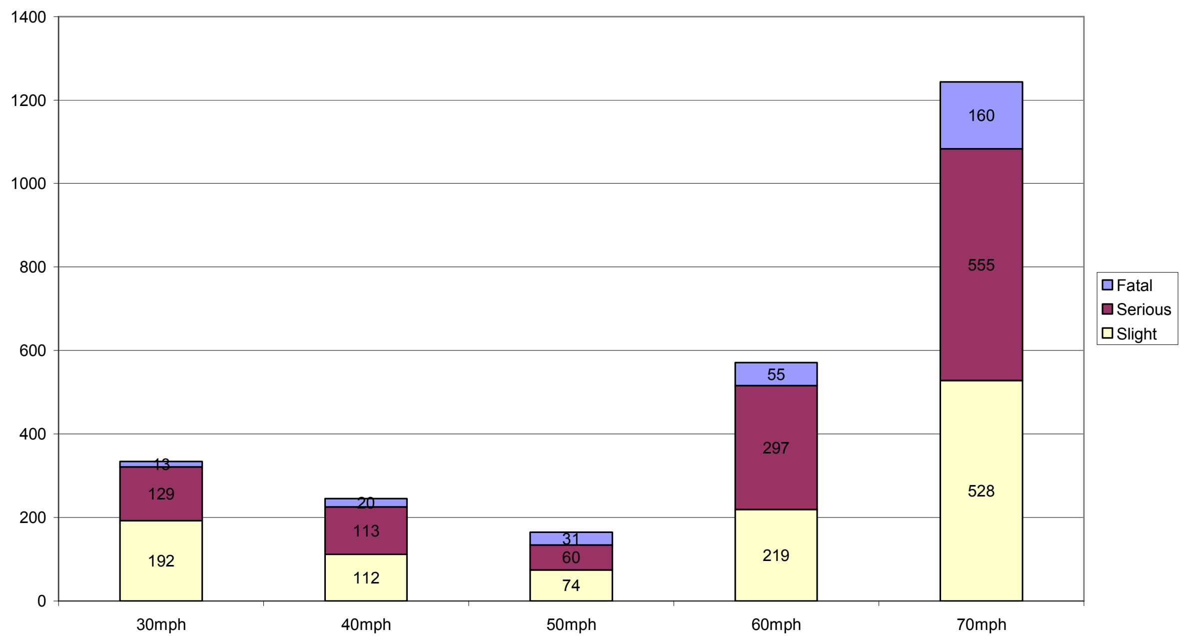


Figure D17 Median Barrier impacts – Road Class

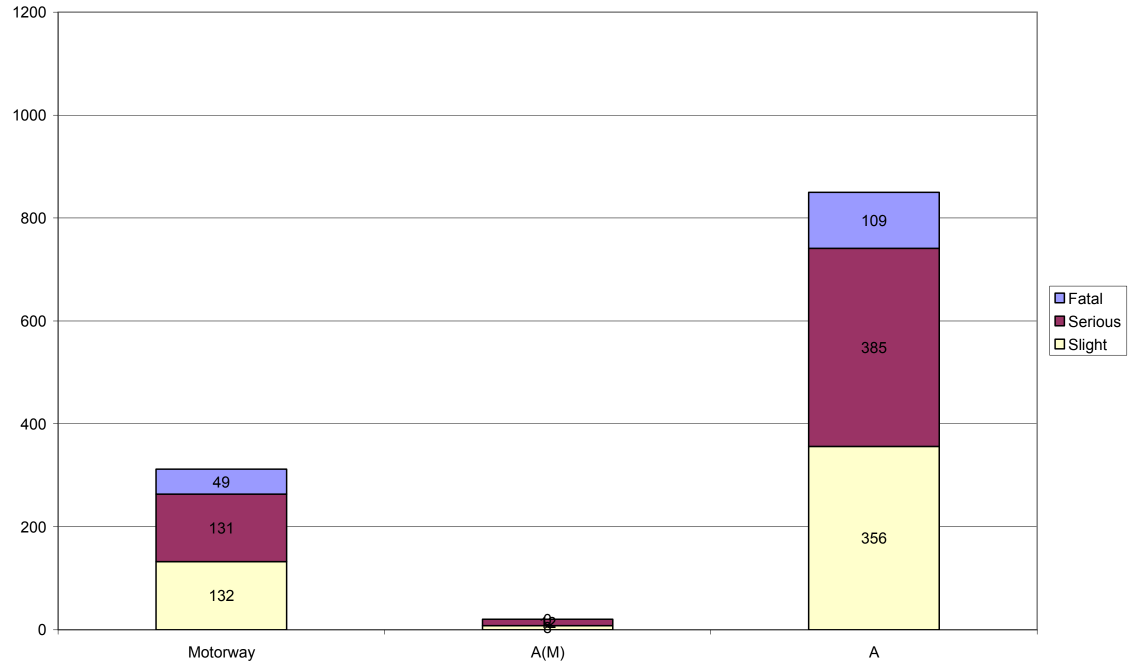


Figure D18 Verge Barrier impacts – Road Class

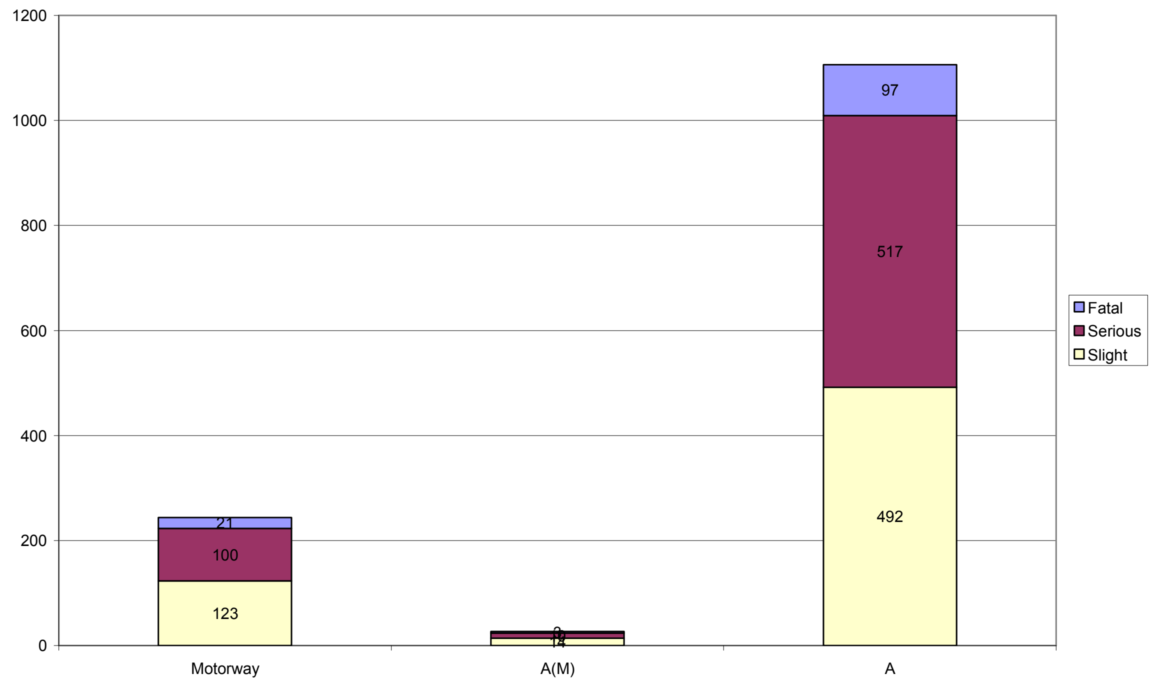


Figure D19 All Barrier impacts – Road Class

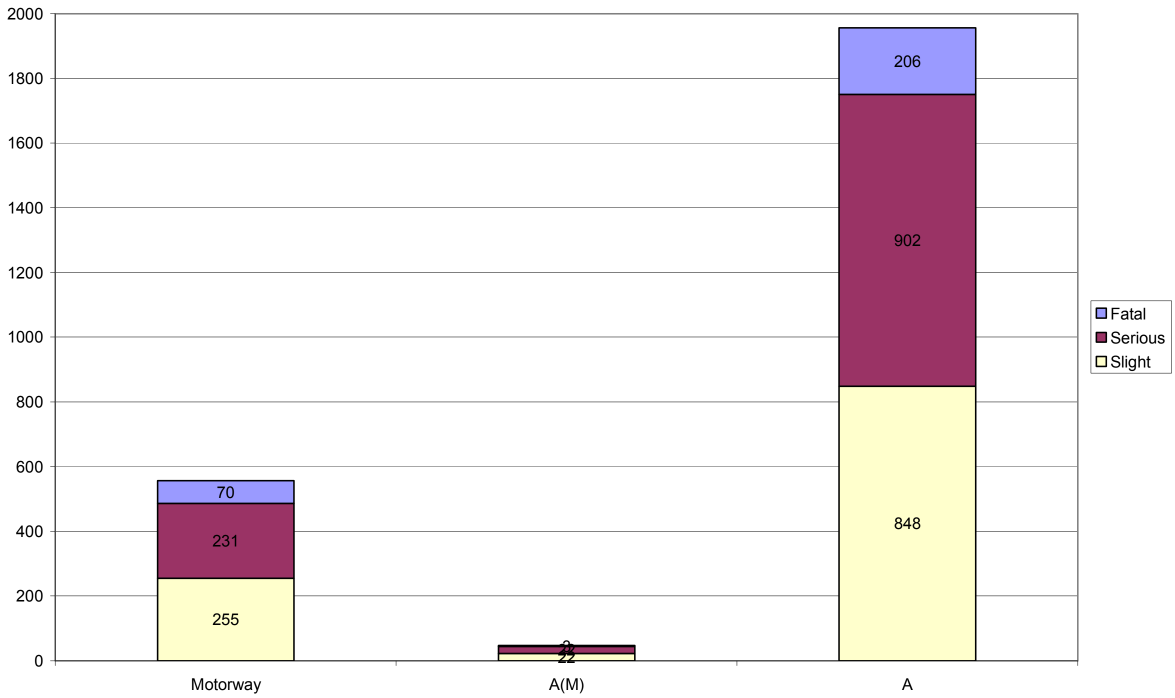


Figure D20 Median Barrier impacts – Object struck in carriageway before barrier

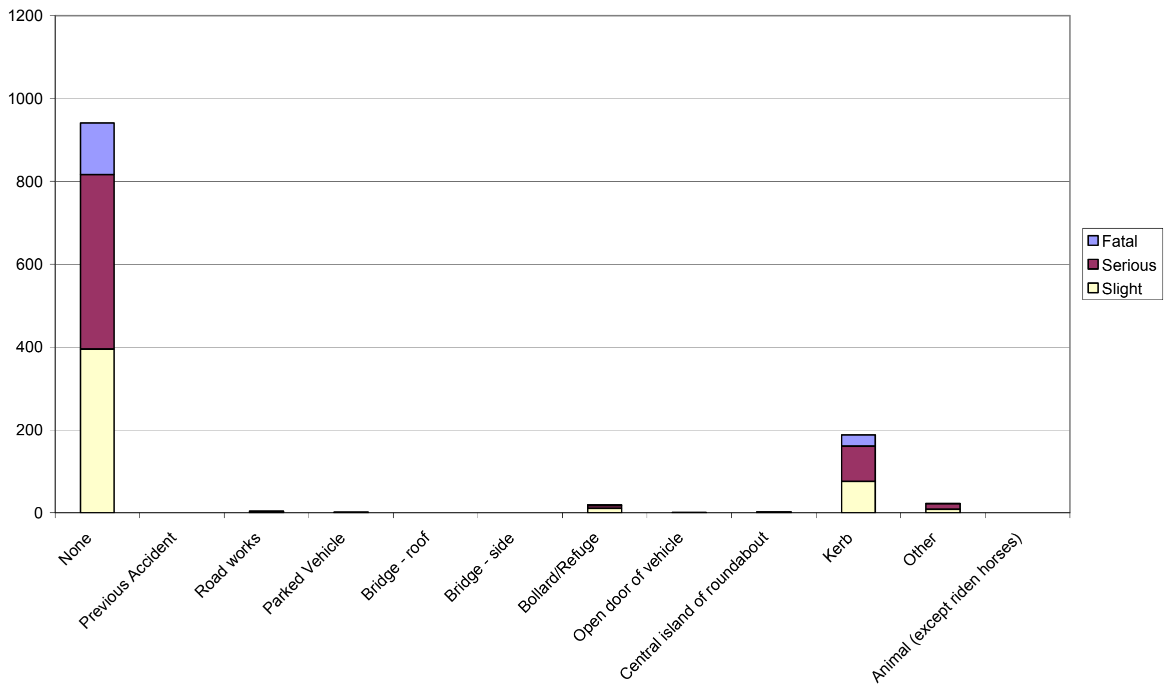


Figure D21 Verge Barrier impacts – Object struck in carriageway before barrier

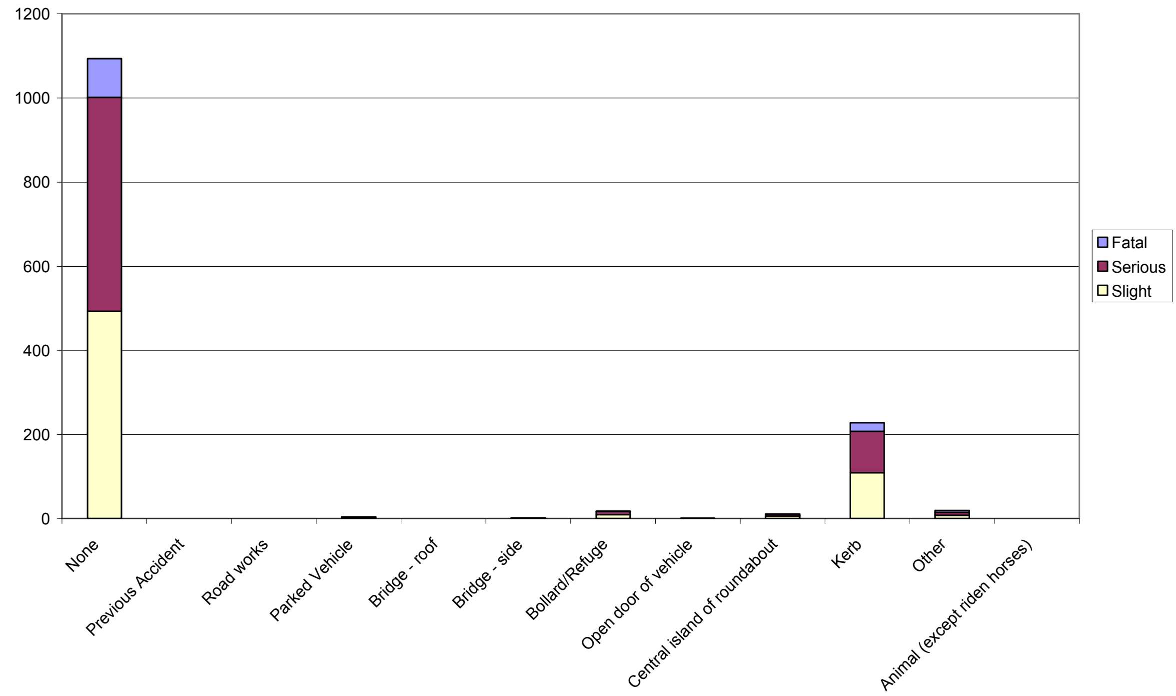


Figure D22 All Barrier impacts – Object struck in carriageway before barrier

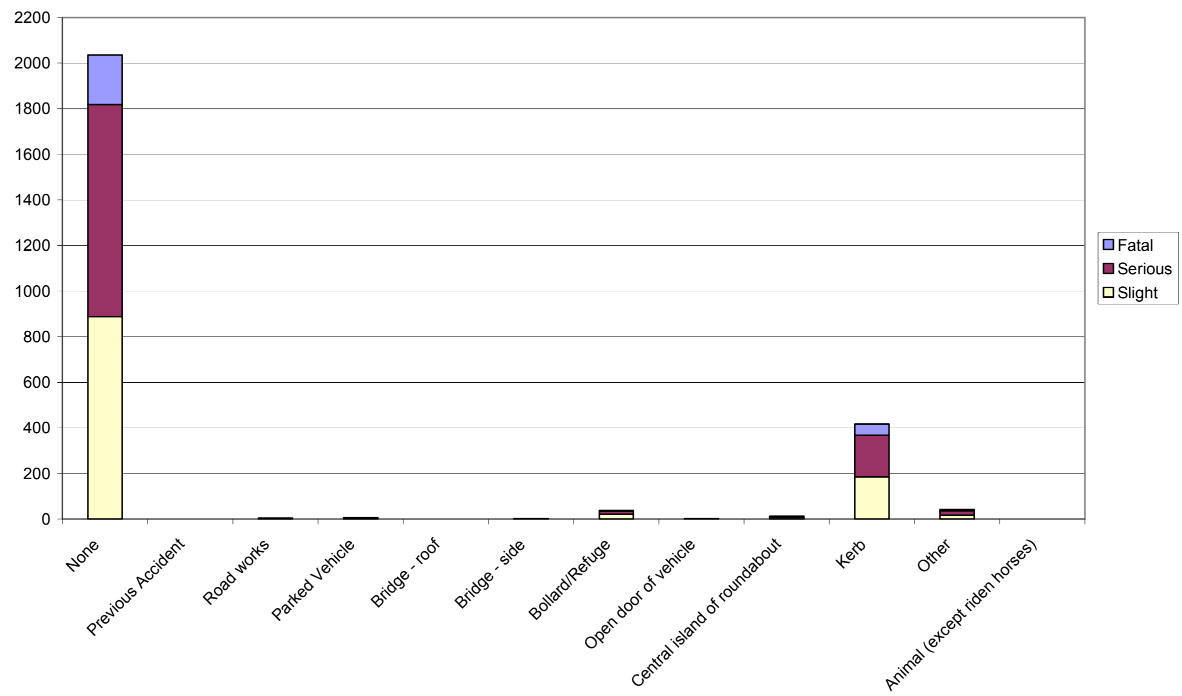


Figure D23 Median Barrier impacts – Lighting Conditions

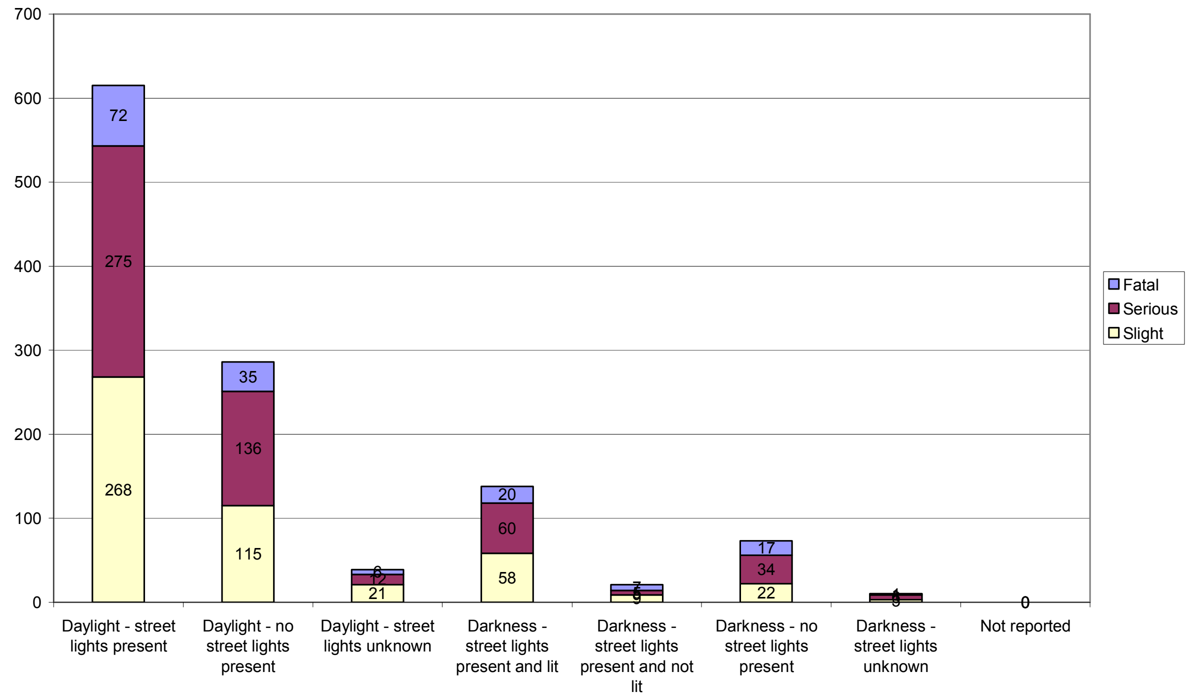


Figure D24 Verge Barrier impacts – Lighting Conditions

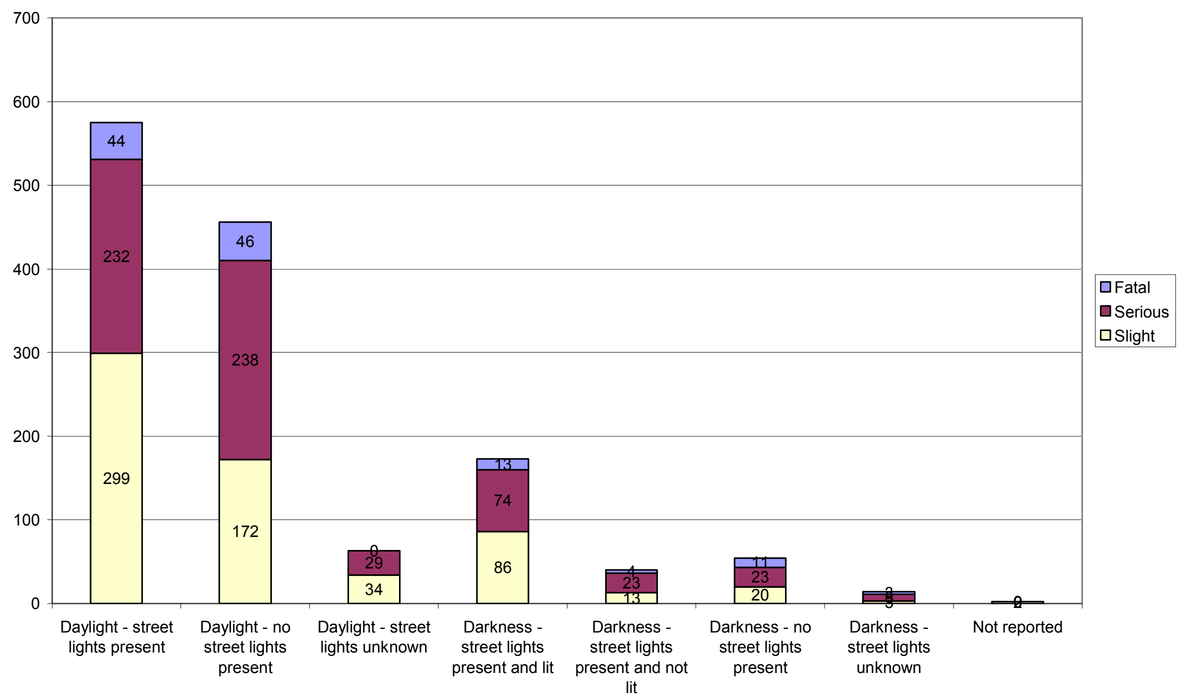


Figure D25 All Barrier impacts – Lighting Conditions

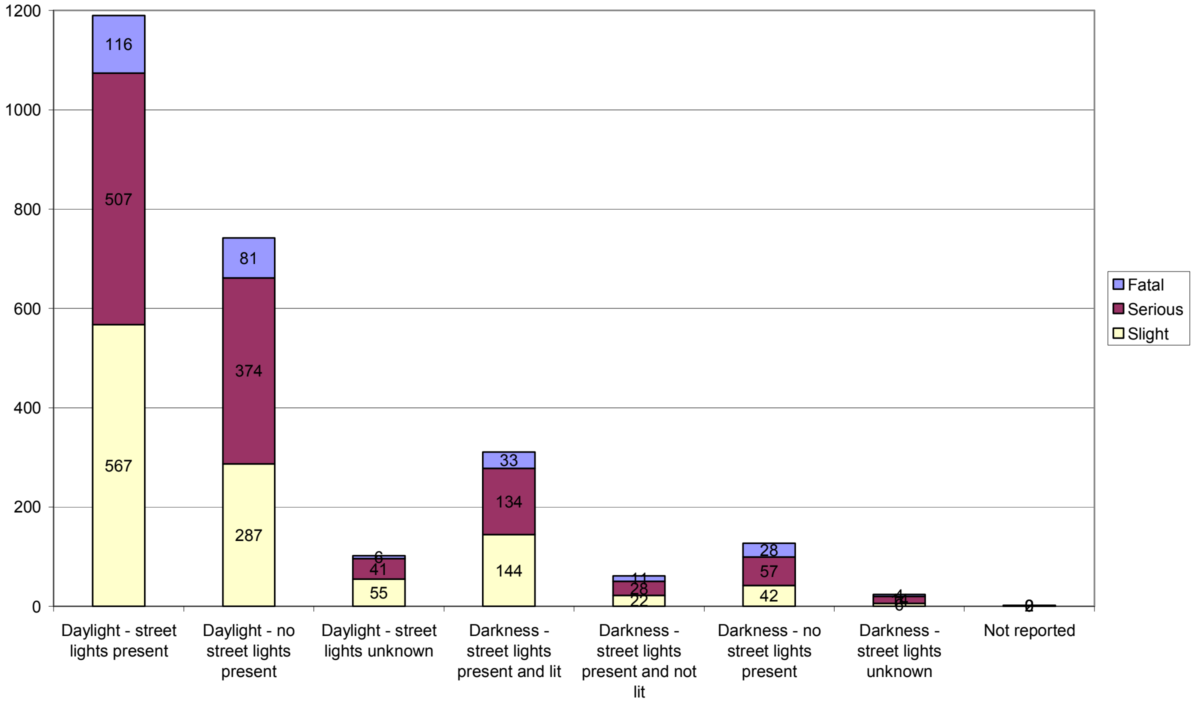


Figure D26 Median Barrier impacts – Weather Conditions

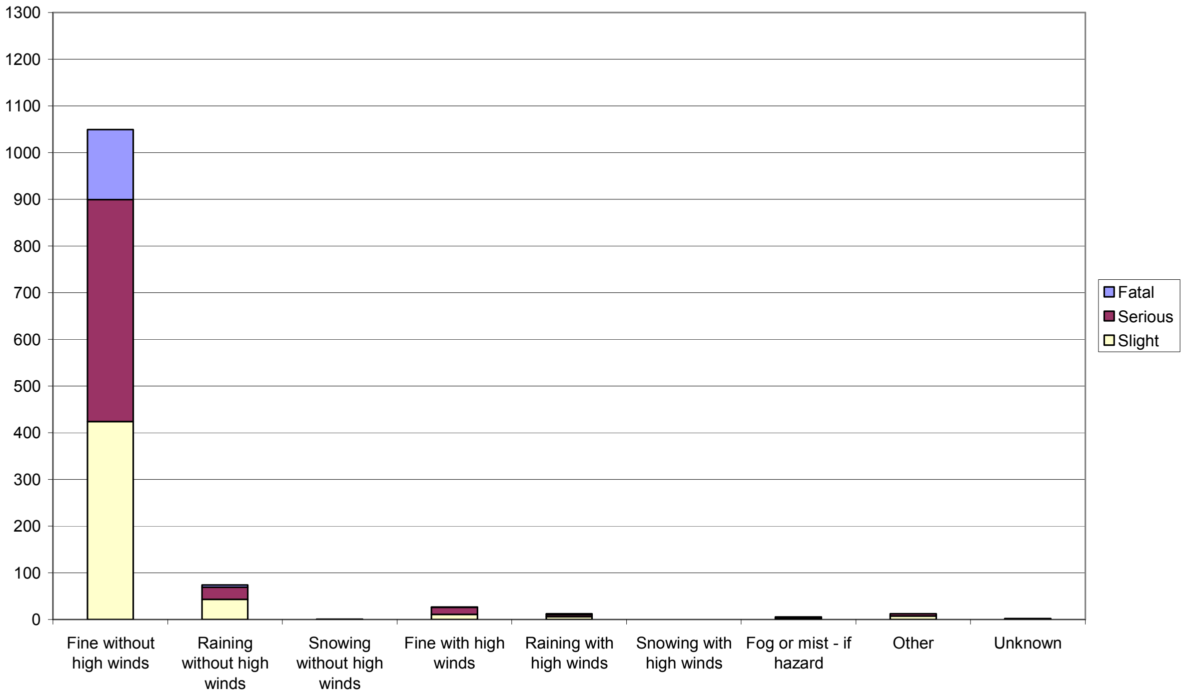


Figure D27 Verge Barrier impacts – Weather Conditions

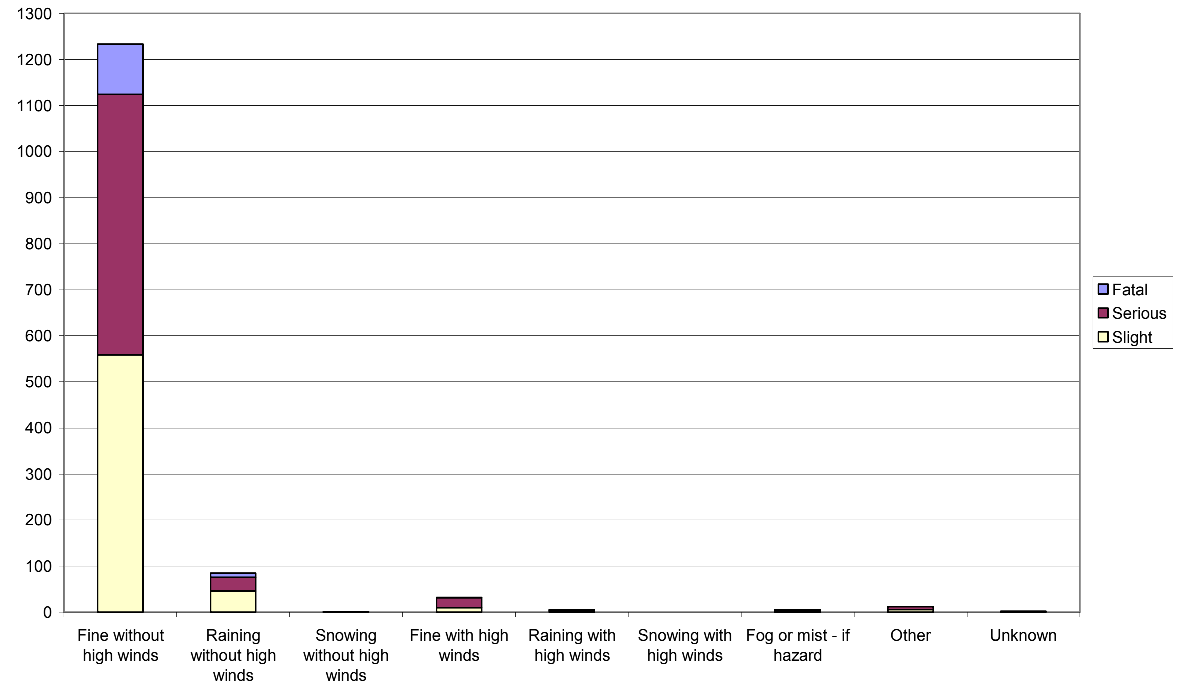


Figure D28 All Barrier impacts – Weather Conditions

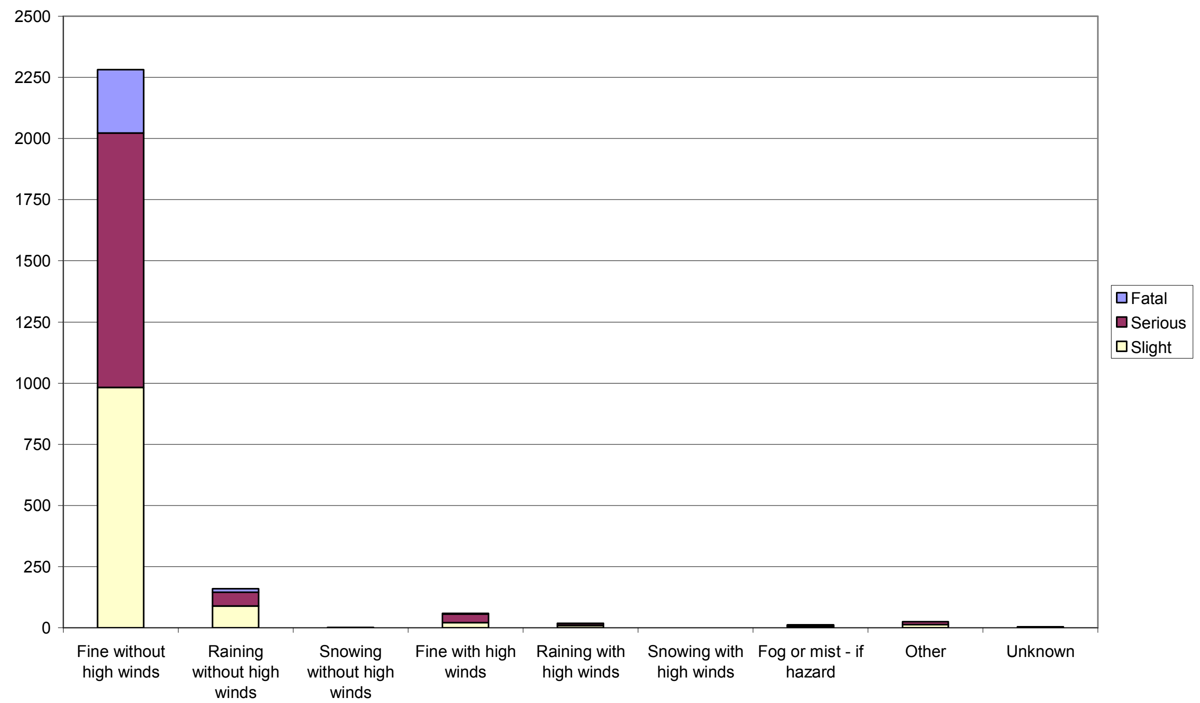


Figure D29 Median Barrier impacts – Road Surface

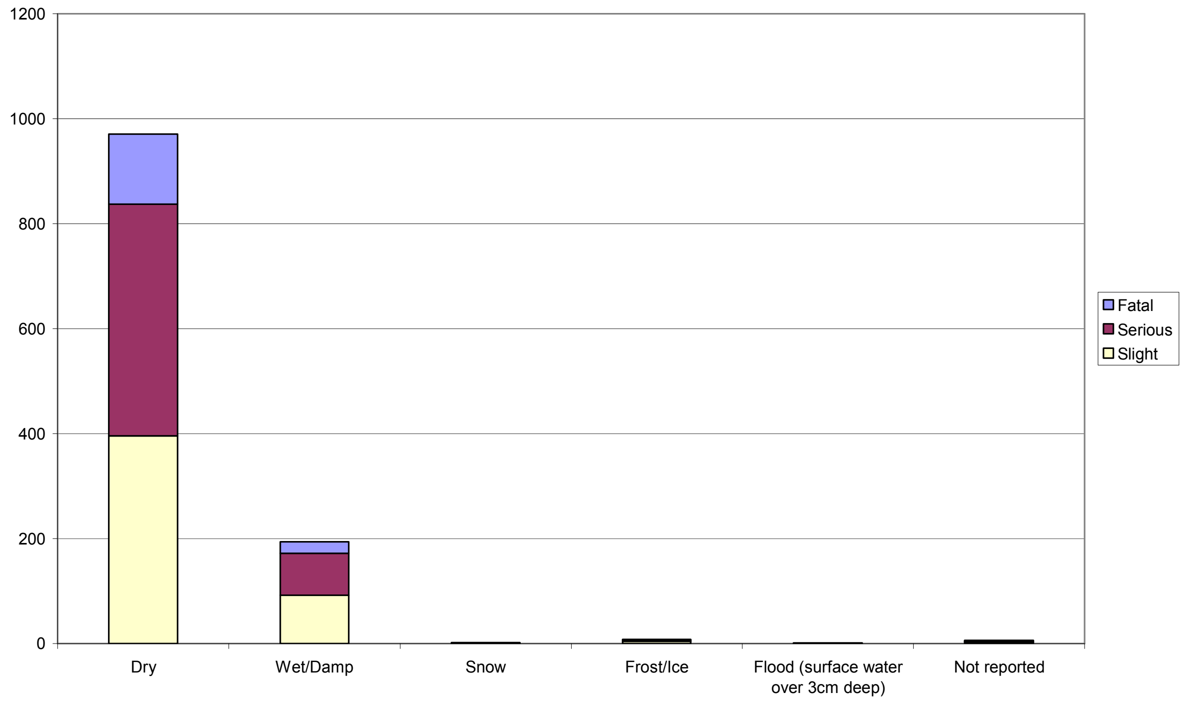


Figure D30 Verge Barrier impacts – Road Surface

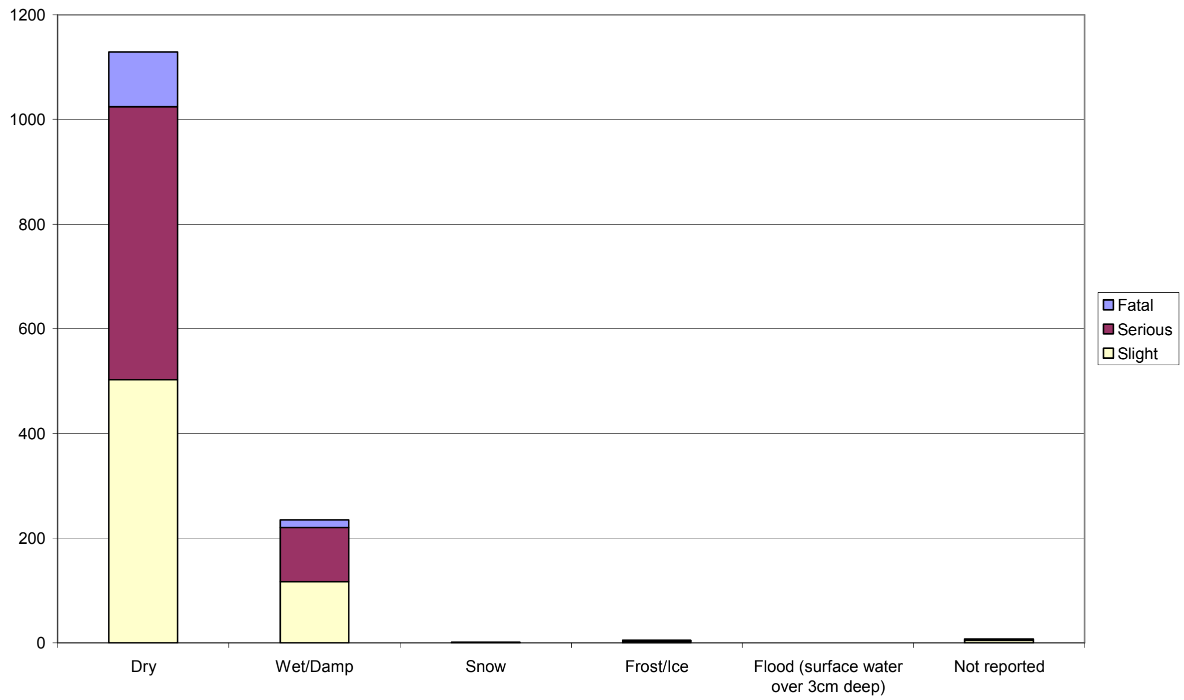


Figure D31 All Barrier impacts – Road Surface

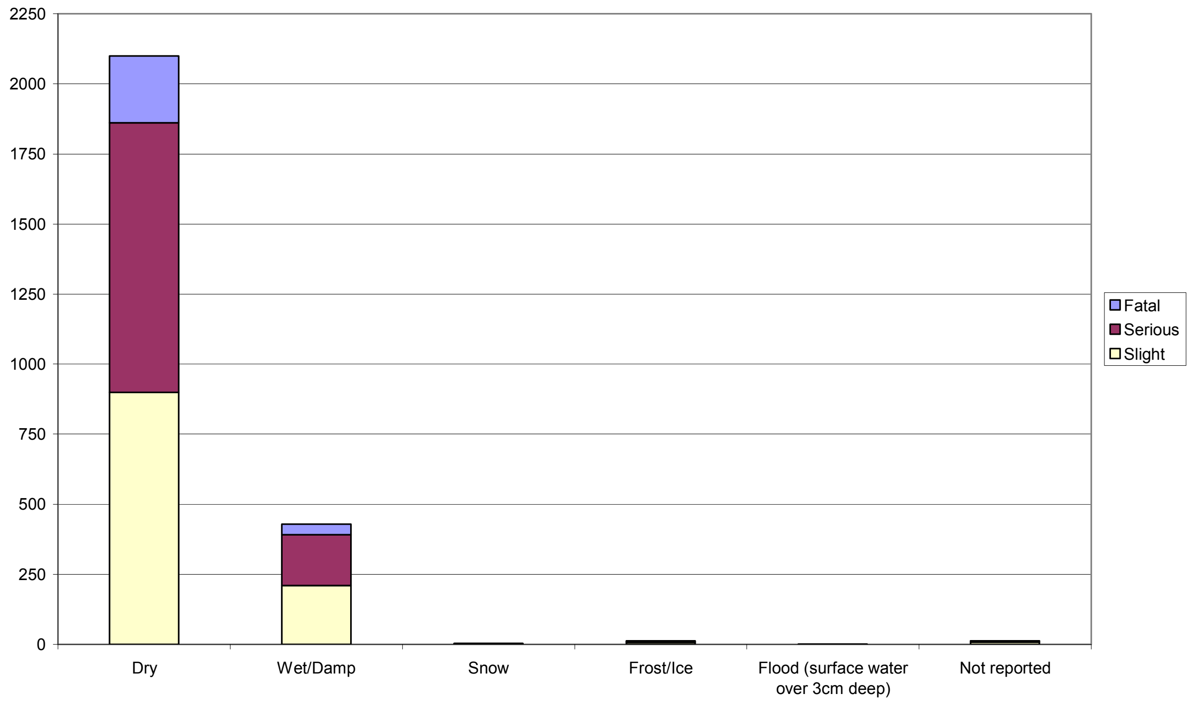


Figure D32 Median Barrier impacts – Sex of casualty

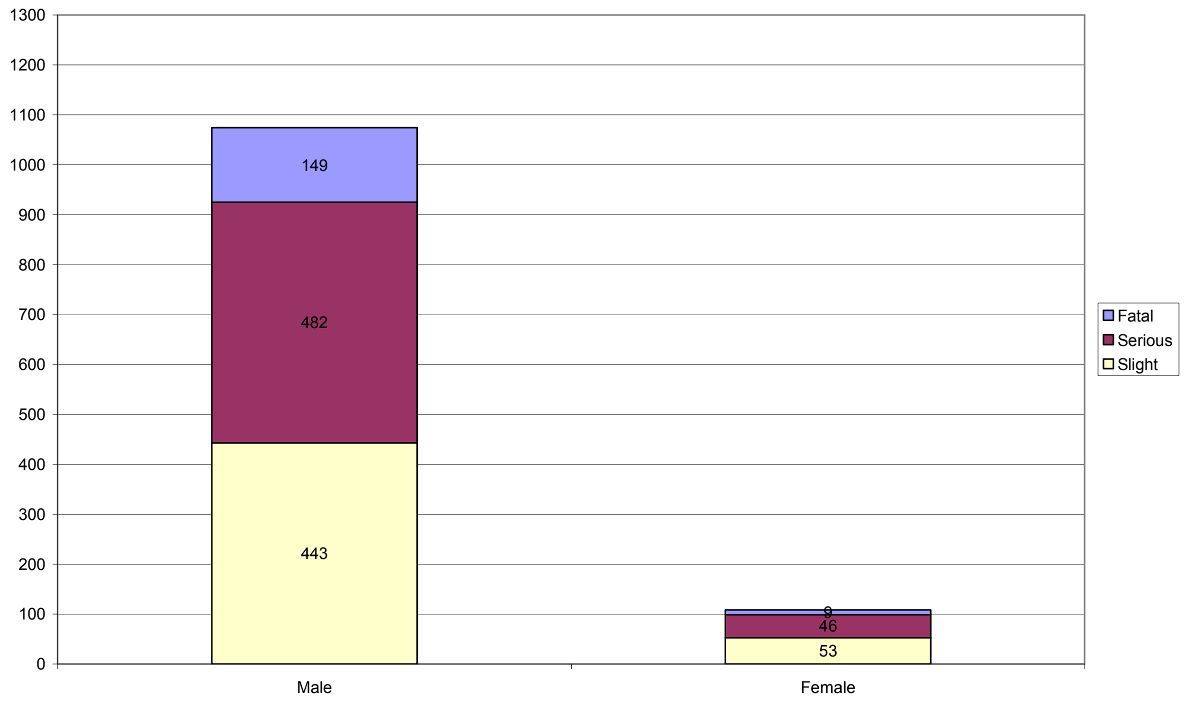


Figure D33 Verge Barrier impacts – Sex of casualty

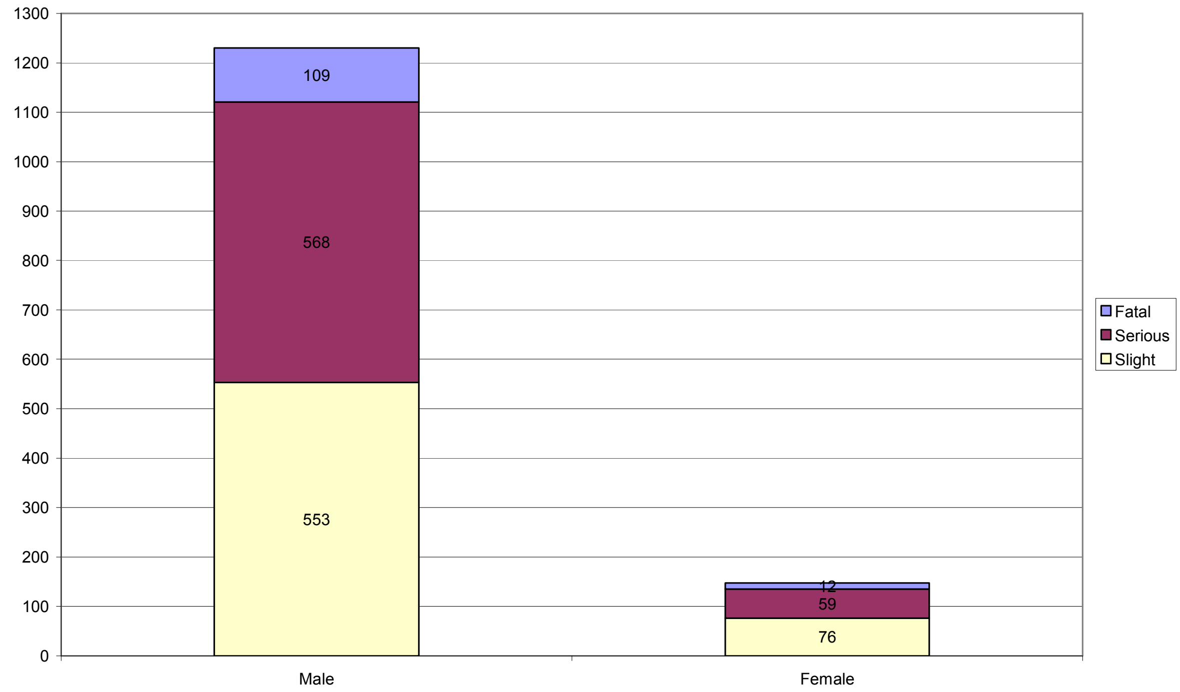


Figure D34 All Barrier impacts – Sex of casualty

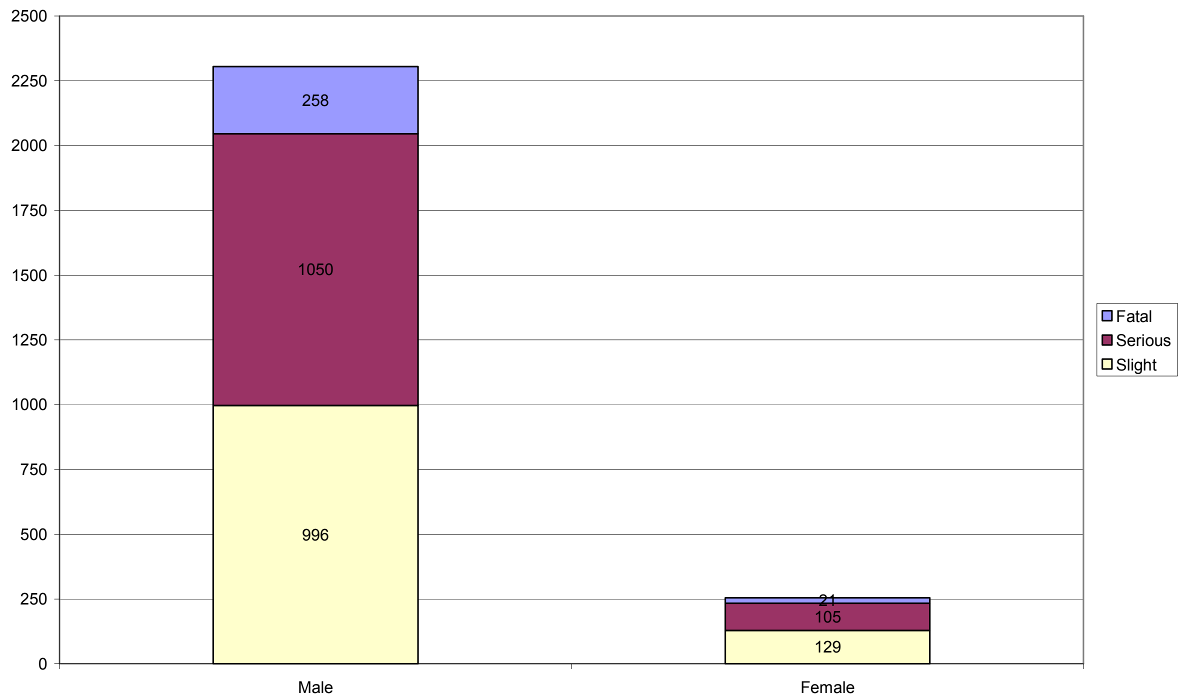


Figure D35 Median Barrier impacts – Age of Casualty

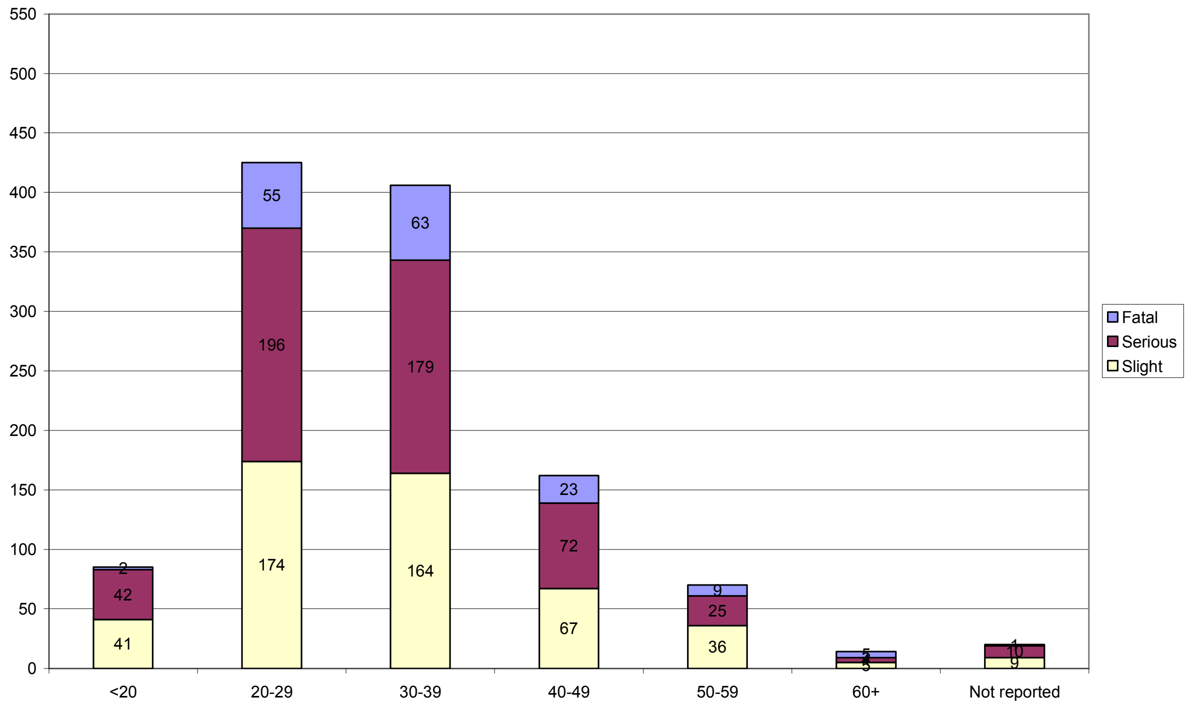


Figure D36 Verge Barrier impacts – Age of Casualty

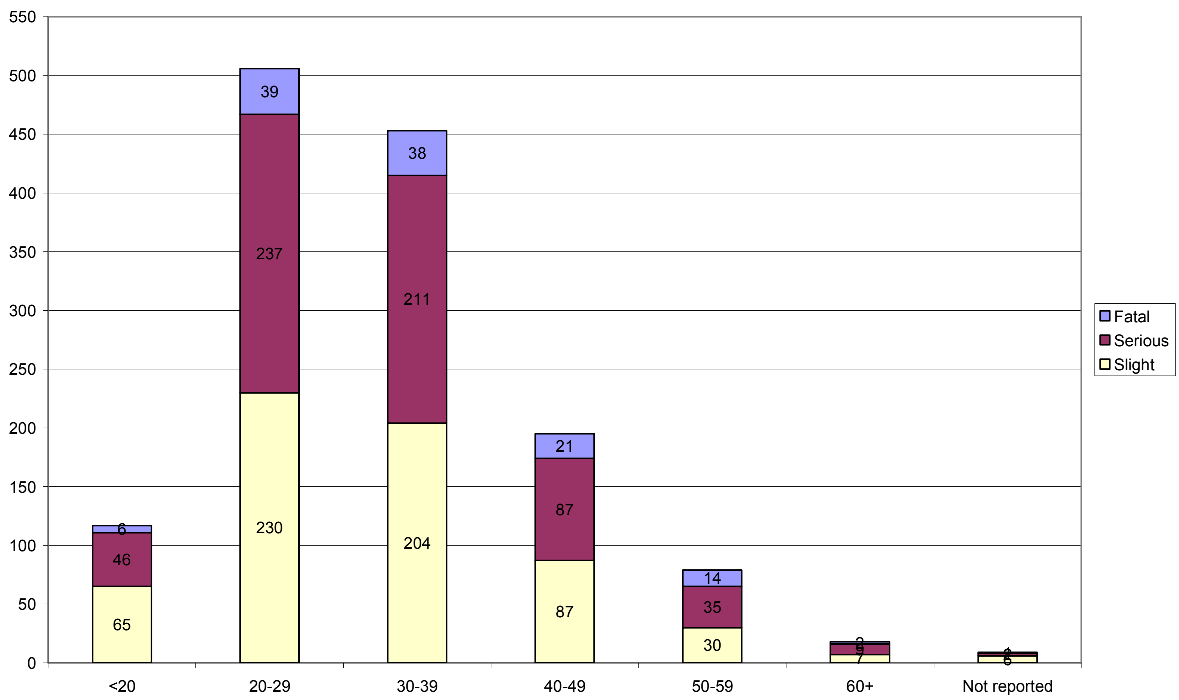


Figure D37 All Barrier impacts – Age of Casualty

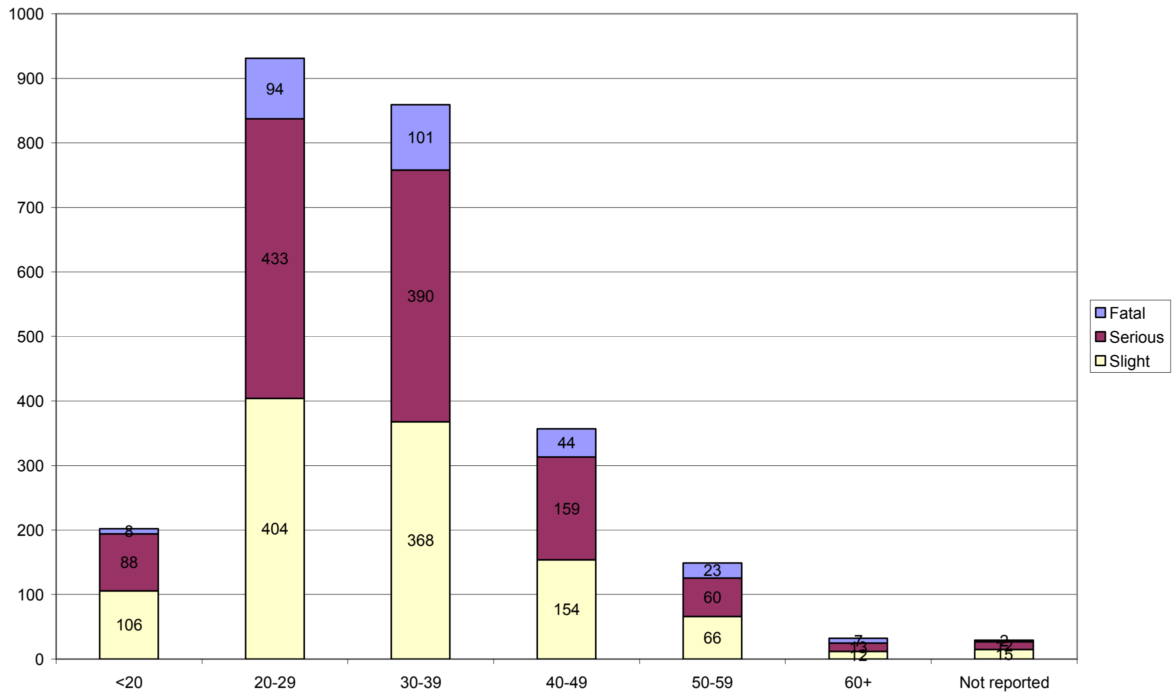


Figure D38 Median Barrier impacts – Year of Accident

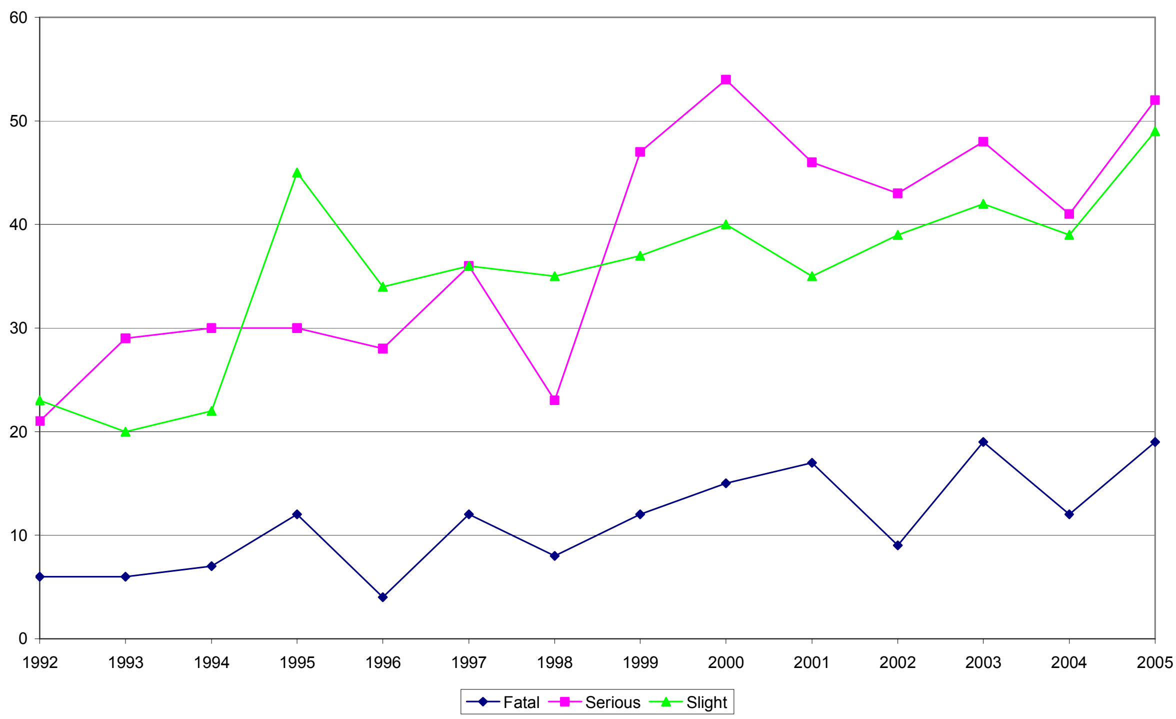


Figure D39 Verge Barrier impacts – Year of Accident

Figure D40 All Barrier impacts – Year of Accident

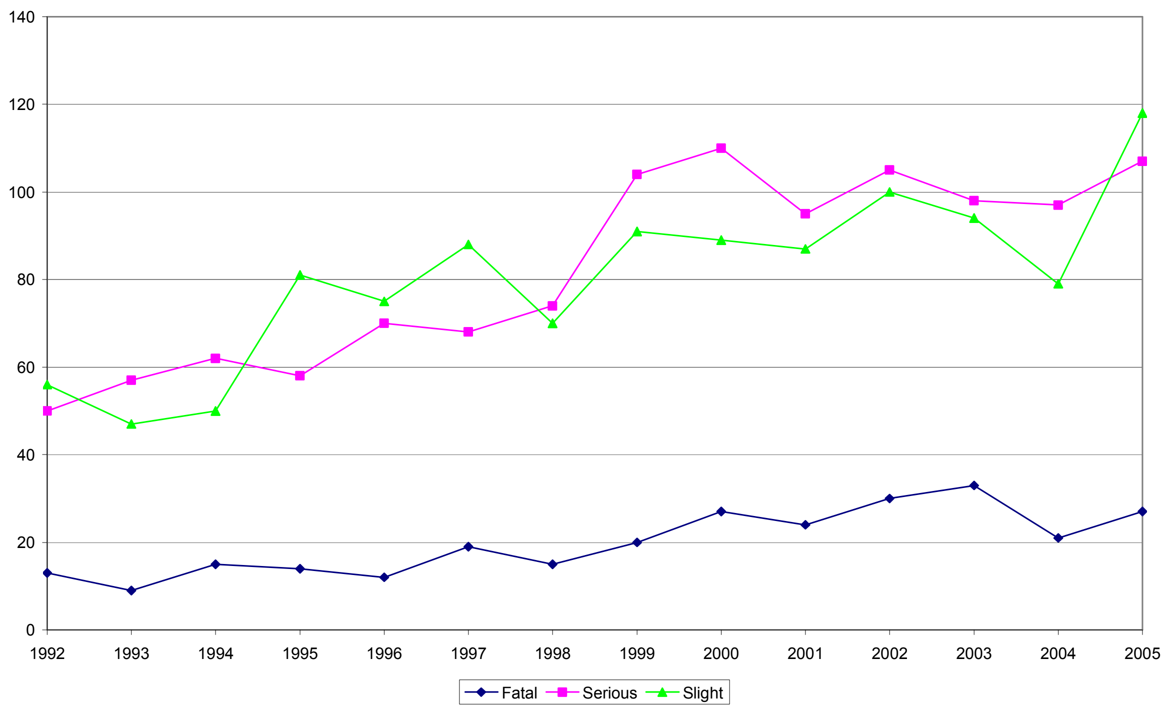
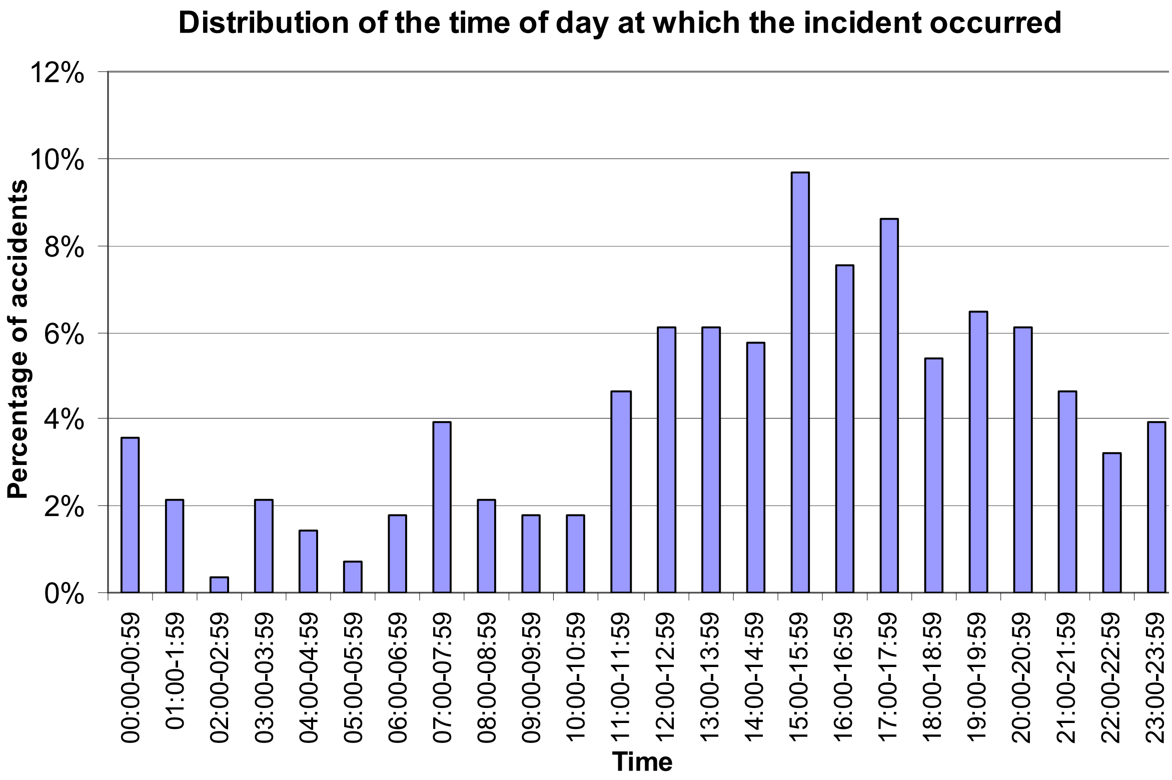


Figure D41: Diurnal distribution



Appendix E Fatal File Analysis Graphs

E1 Introduction

Police fatal accident reports are recognised as an important source of information for accident research. They can provide detailed information on the events leading up to an accident as well as detailing the driver errors and/or vehicle defects which may have contributed to it, and the injuries which resulted in the fatality.

These fatal accident reports cost a great deal to produce, both in terms of police and pathologists' time. The reports are produced, even where no criminal prosecution is envisaged, for presentation in evidence at the Coroner's inquest.

In 1992, TRL was commissioned by Department for Transport (DfT) to set up and manage the police fatal road traffic accident files project. The purpose of this project was to institute a scheme whereby police forces in England and Wales would routinely send fatal road accident reports to TRL when they were no longer of use for legal processes. Due to uncertainties about the different legal system in Scotland, Scottish police files were not (and are still not) collected by the project. As a result, the Scottish police forces will be contacted on an individual basis to request access to the relevant fiscal reports, and these will be used to update the findings of this report as soon as possible.

A project was set up to persuade as many police forces as possible to send finished reports to TRL. At TRL, the reports are sorted, catalogued, and stored to enable researchers to create a greater understanding of the causes of these tragic accidents, in order to develop effective behavioural and engineering countermeasures.

The fatal reports provide a unique insight into how and why fatal accidents occur on the UK road network. The data contained within them is not available from any other source. The reports provide an exclusive opportunity to learn from these tragic accidents, so that we can work towards reducing the number of fatal accidents which occur in the UK and the World.

Police fatal accident reports are recognised as an important source of information for accident research. They can provide detailed information on the events leading up to an accident and the road and roadside features, as well as detailing the driver errors and/or vehicle defects which may have contributed to it, and the injuries which resulted in the fatality.

These reports are comprehensive, and include witness statements, reports by accident investigation and vehicle examination specialists, sketch plans showing pre-impact trajectories and post-impact positions of vehicles and transcriptions of interviews with drivers and witnesses. This detailed information is not available from any other source and is required if a full understanding of the causes of an accident are to be understood.

Phase I of the project started in 1992, initially collecting files from five police forces, then gradually increasing the number of cooperating forces. By the end of Phase I every police force in England and Wales were donating their files with the exemption of the City of London police (who are responsible for the Square Mile in Central London).

Phases II, III & IV of the project have continued to collect, catalogue and store police fatal files in the same manner as Phase I, with the files being catalogued on their receipt. Each file is given a unique TRL number, which is then stored in a database table. Each TRL accident number is then linked to its corresponding STATS19 accident number.

By linking each fatal accident to its STATS19 number, groups of accidents, which meet certain criteria, can be quickly identified. These accident files can then be retrieved from the central library, so that further details of the accident can be obtained and analysed.

Due to an increased pressure on police force storage many police forces have taken greater advantage of the project's free storage facilities. The average age of files received from police forces has therefore reduced; this has made the information held within the archive more representative of current trends. However, it should be noted that due to this decrease in the age of files received, the likelihood of police forces requesting the return of a file has increased.

Figure E1: Motorcycle age distribution

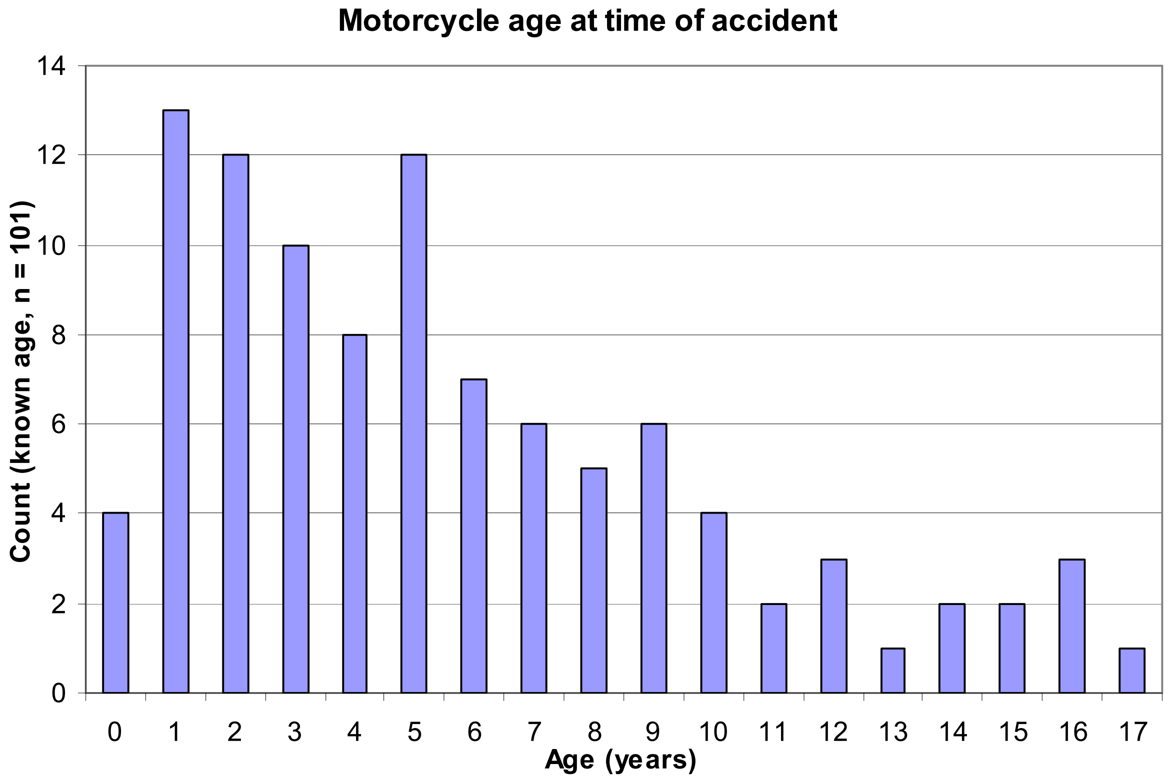


Figure E2: Motorcycle engine size distribution

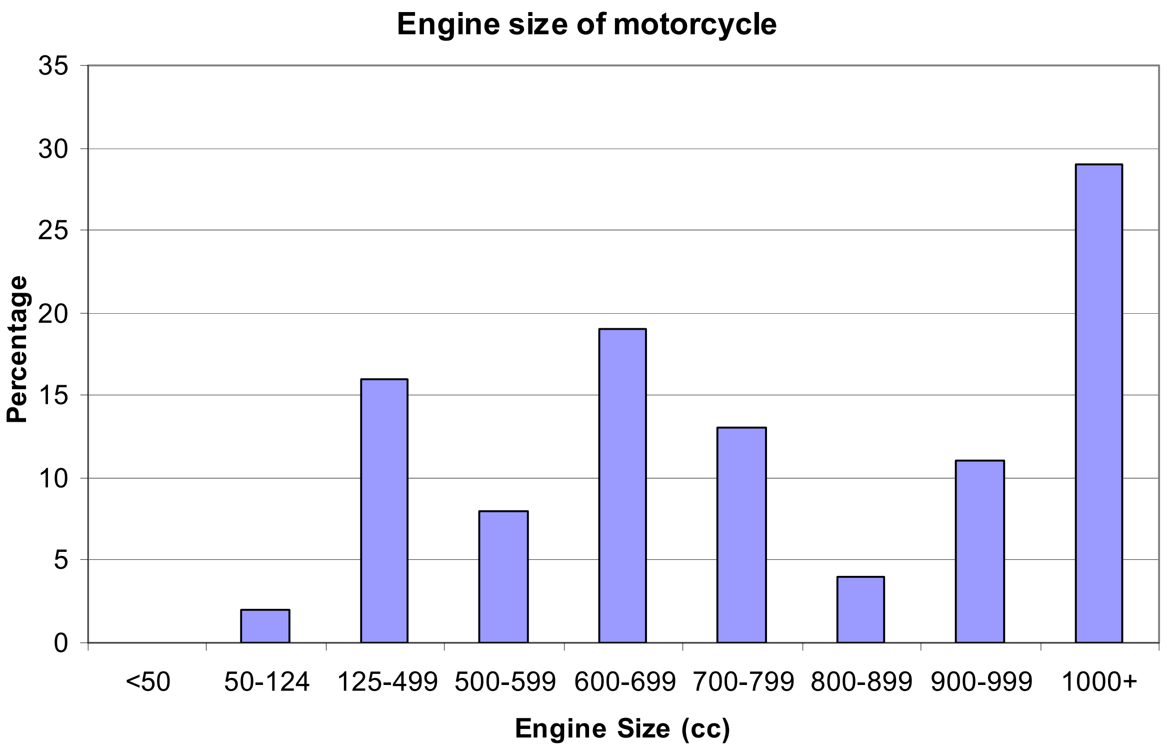


Figure E3: Safety fence type distribution

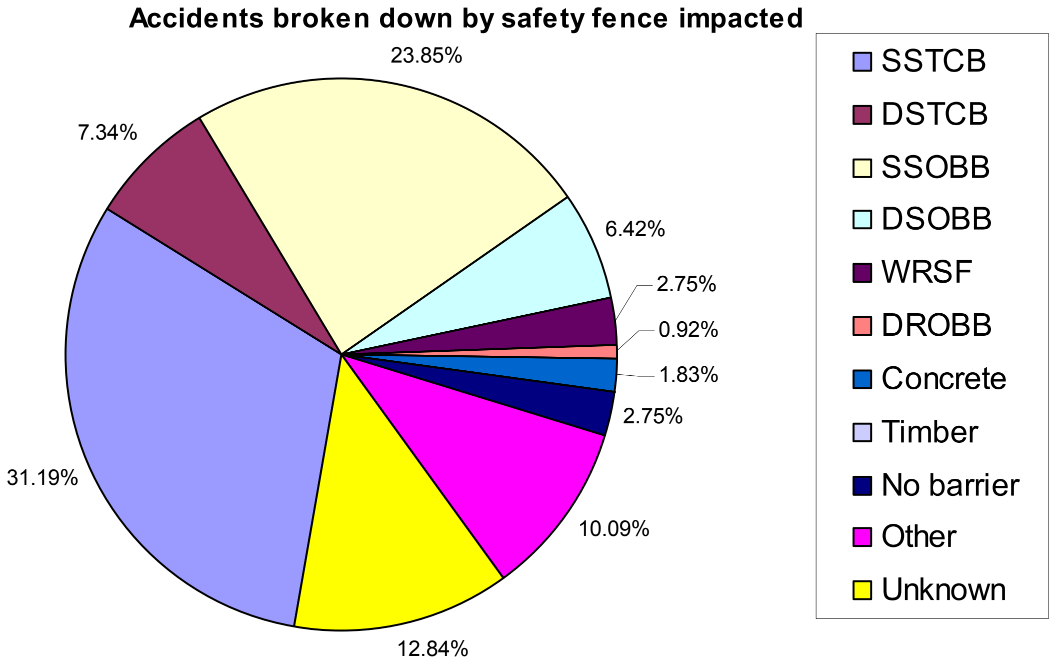


Figure E4: Point of contact distribution: all accidents

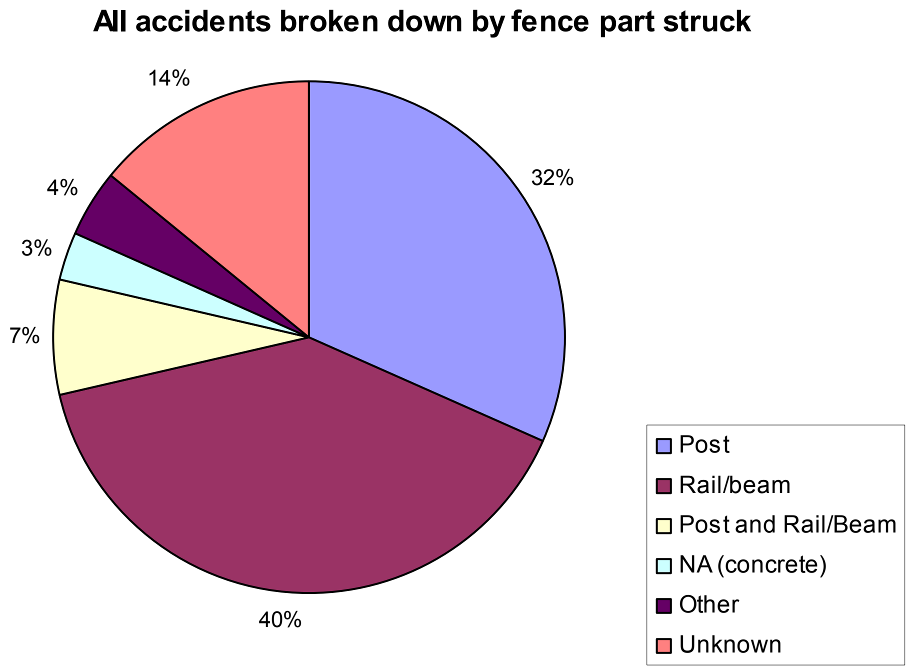


Figure E5: Point of contact distribution, SSTCB

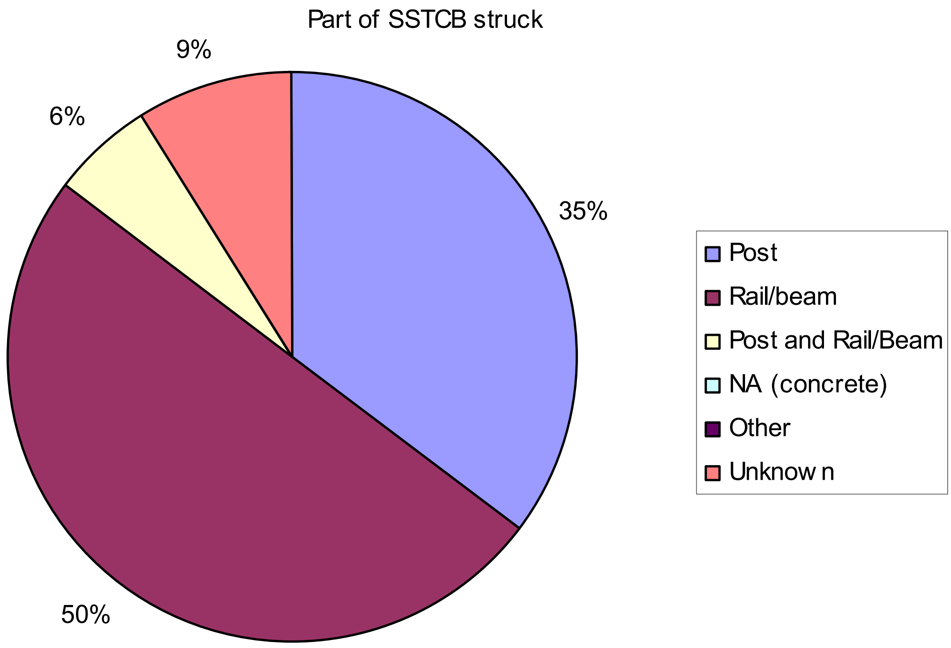


Figure E6: Point of contact distribution, DSTCB

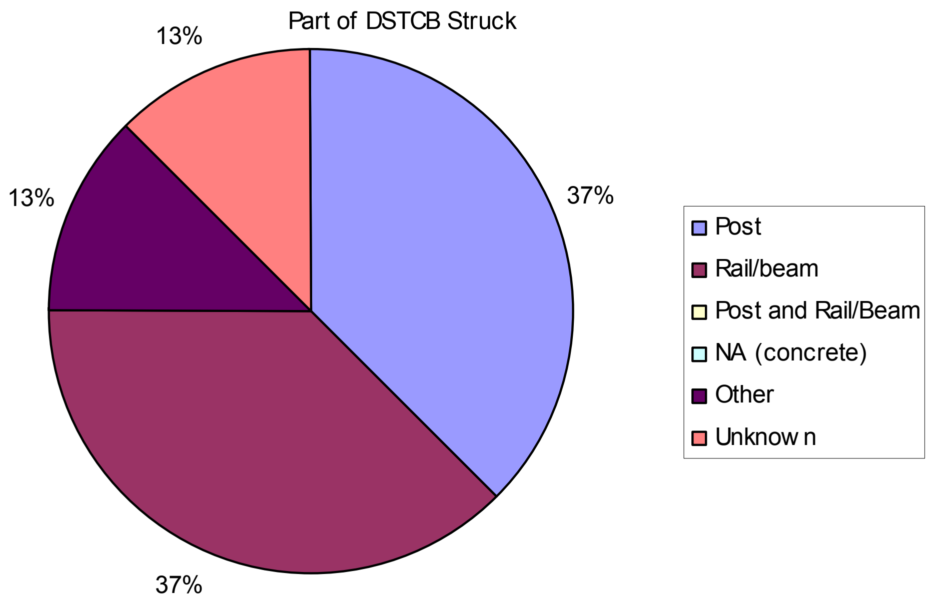


Figure E7: Point of contact distribution, SSOBB

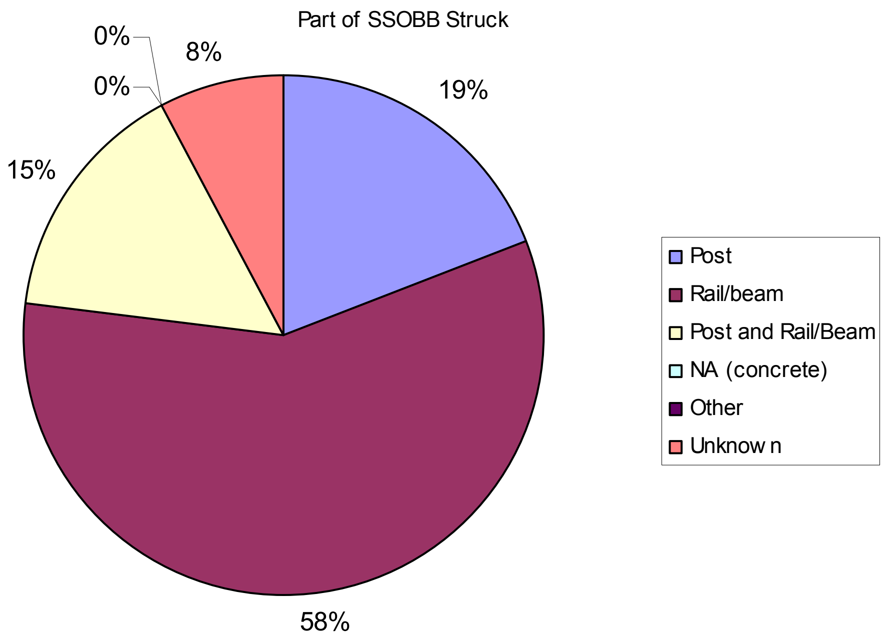


Figure E8: Point of contact distribution, DSOBB

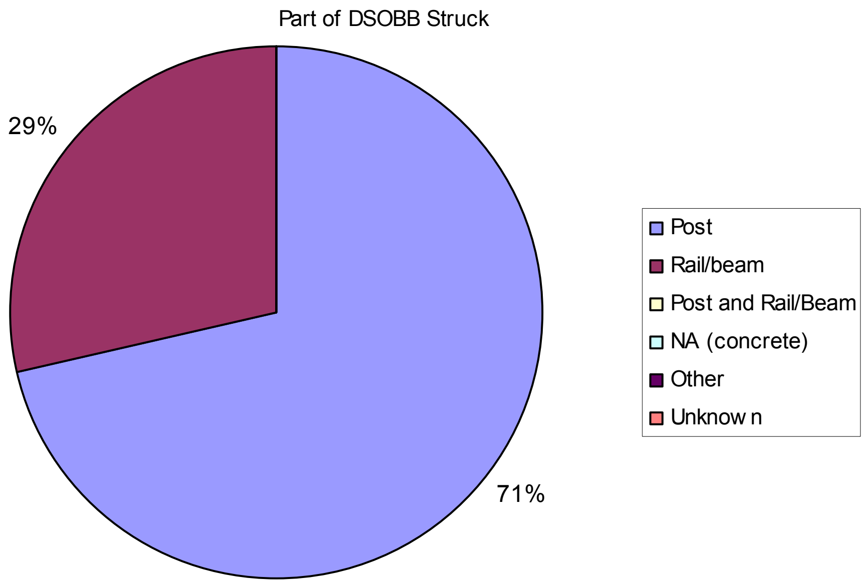


Figure E9: Point of contact distribution, WRSF

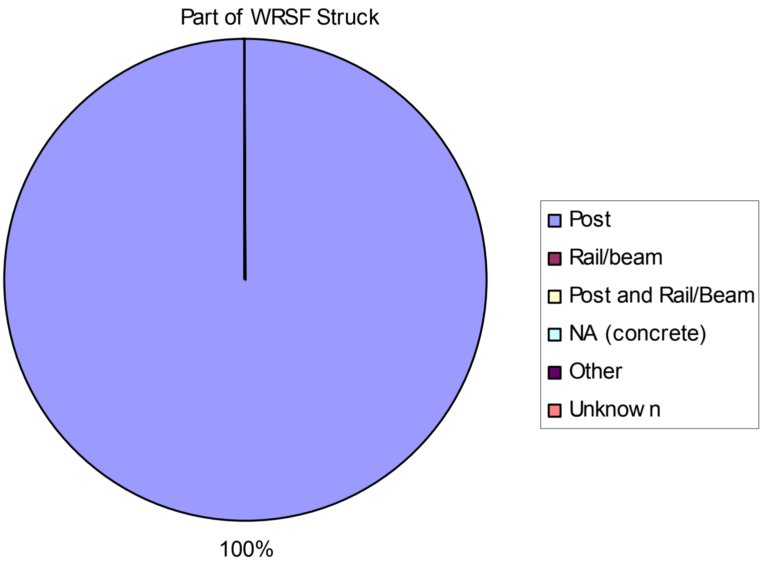


Figure E10: Point of contact distribution, rider mounted

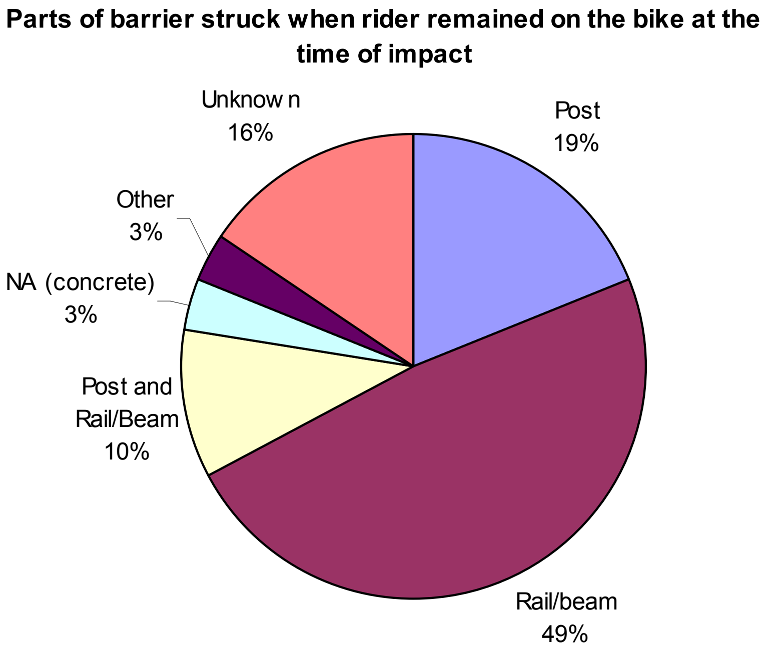


Figure E11: Point of contact distribution, rider detached

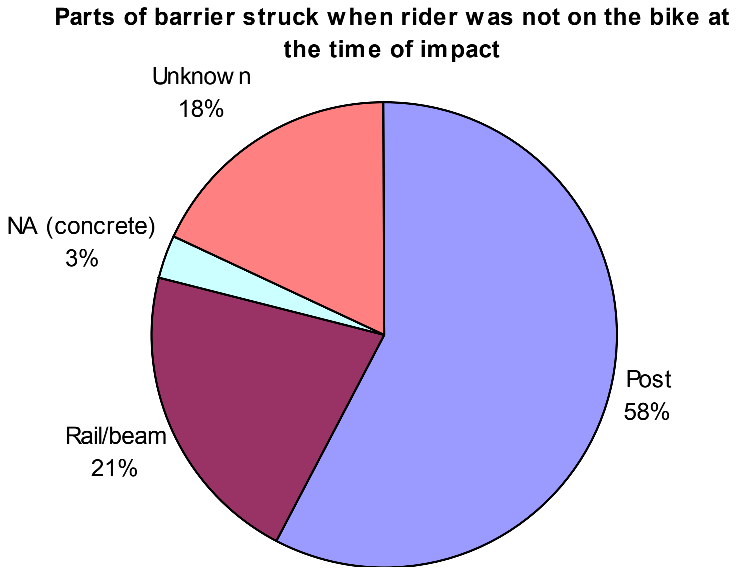


Figure E12: Engagement with barrier

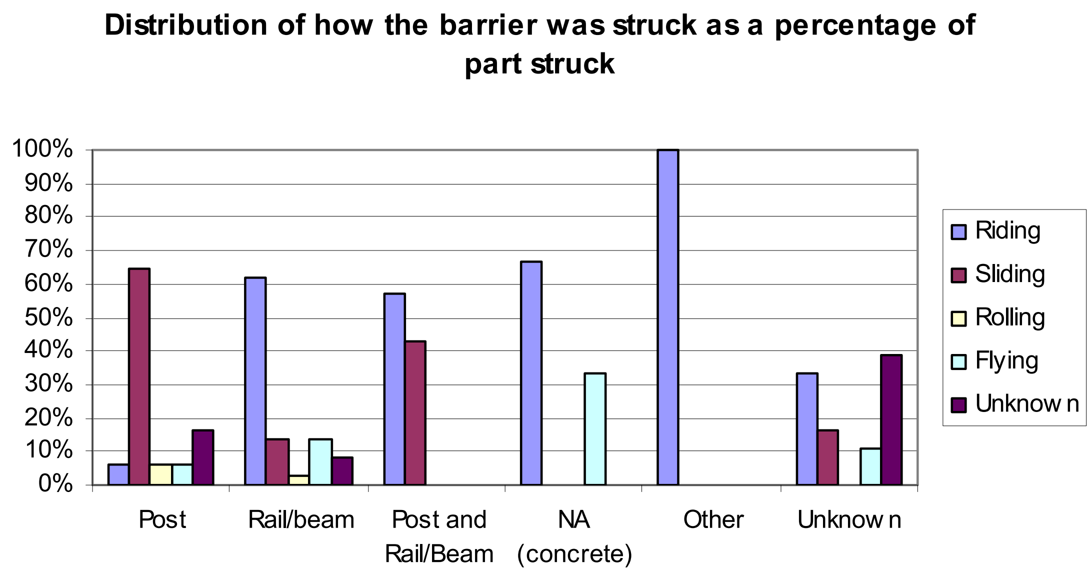


Figure E13: Engagement with barrier parts

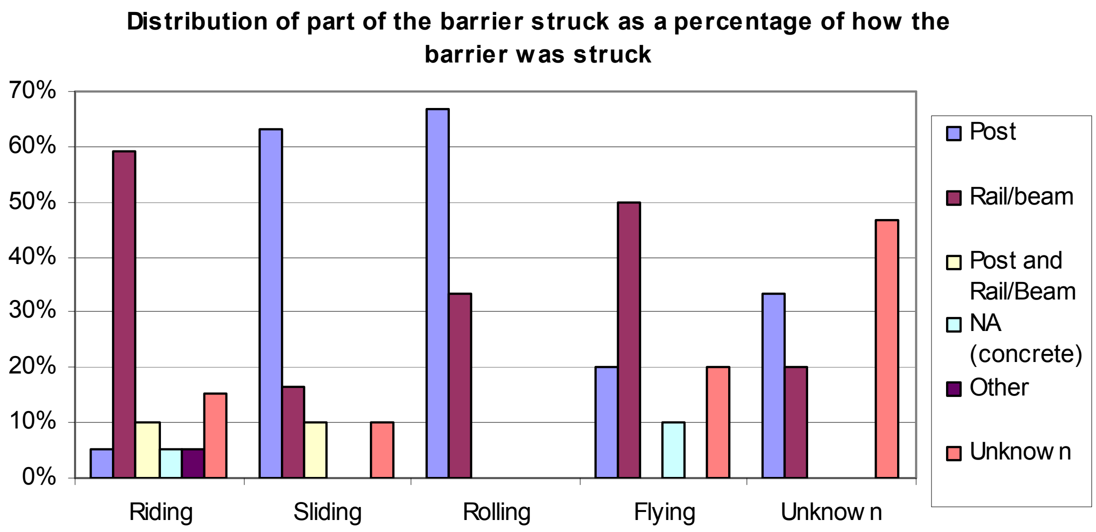


Figure E14: Cause of death following contact with post

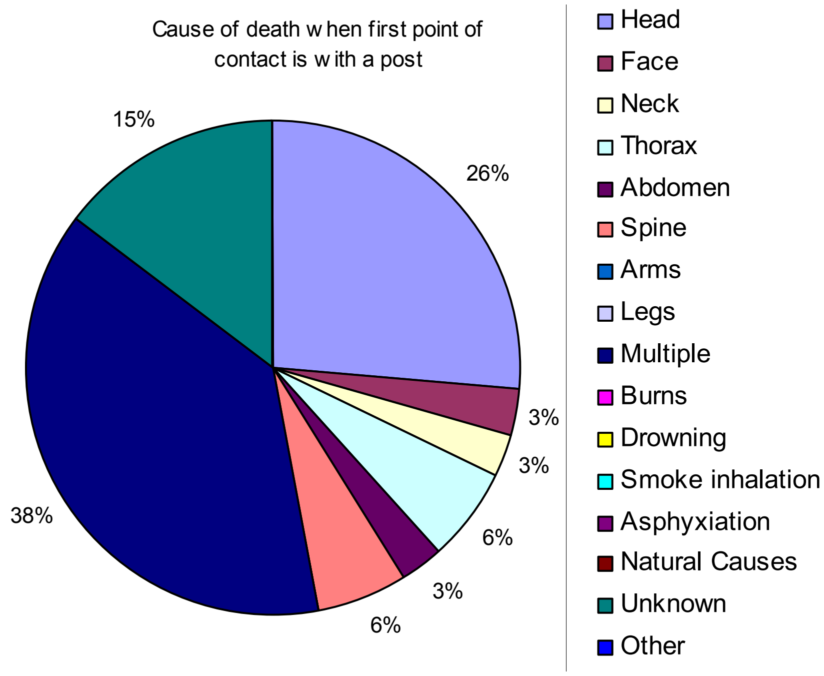


Figure E15: Cause of death following contact with rail or beam

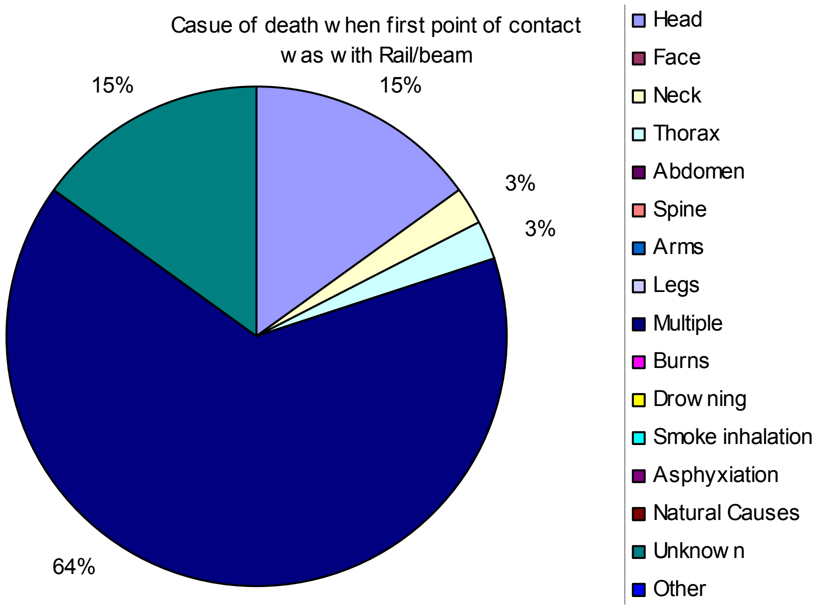


Figure E16: Cause of death following contact with post and rail or beam

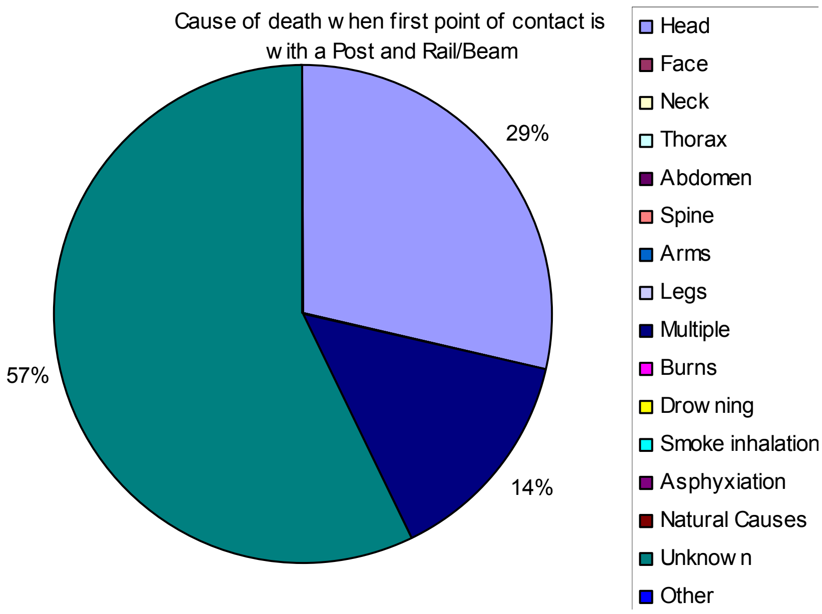


Figure E17: Protective clothing worn

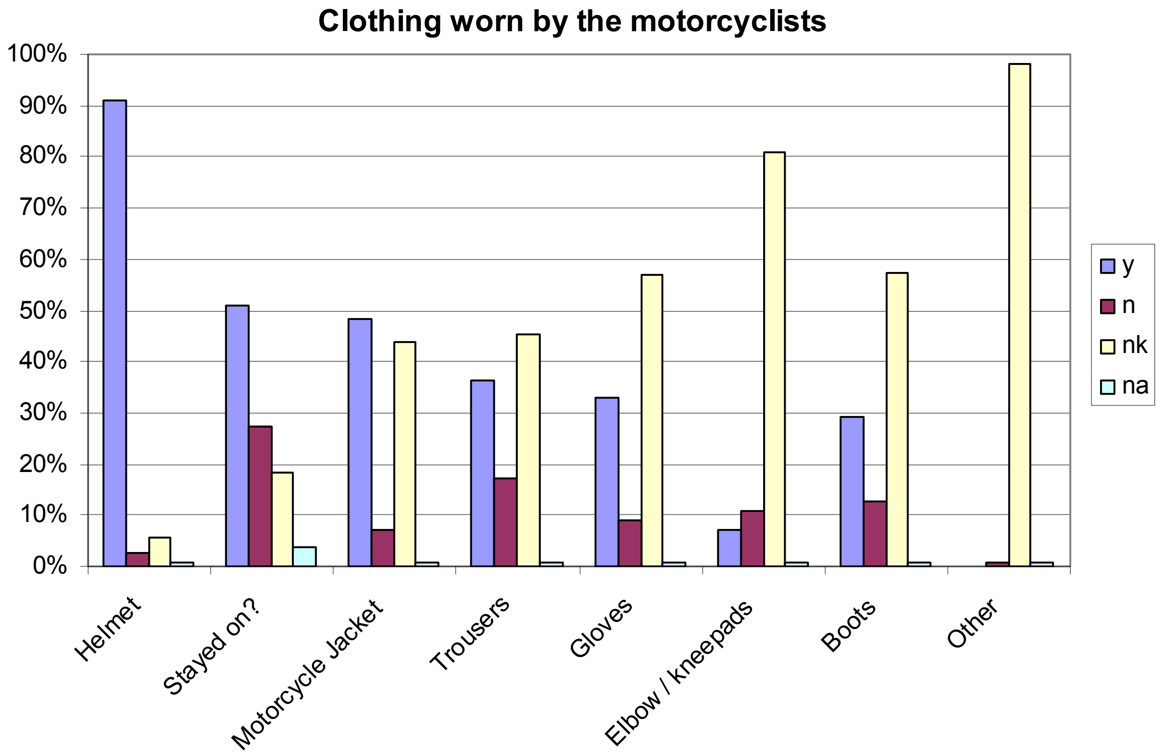


Figure E18: Helmet use and retention

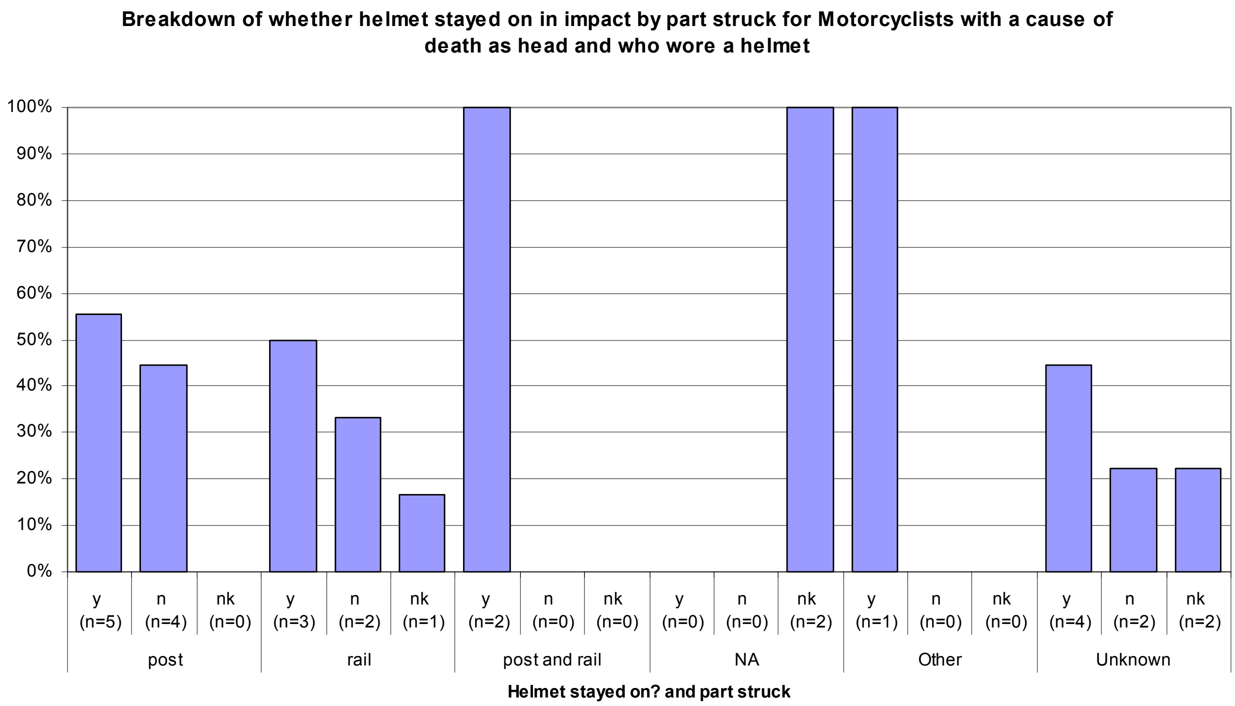


Figure E19: Multiple injuries from part struck

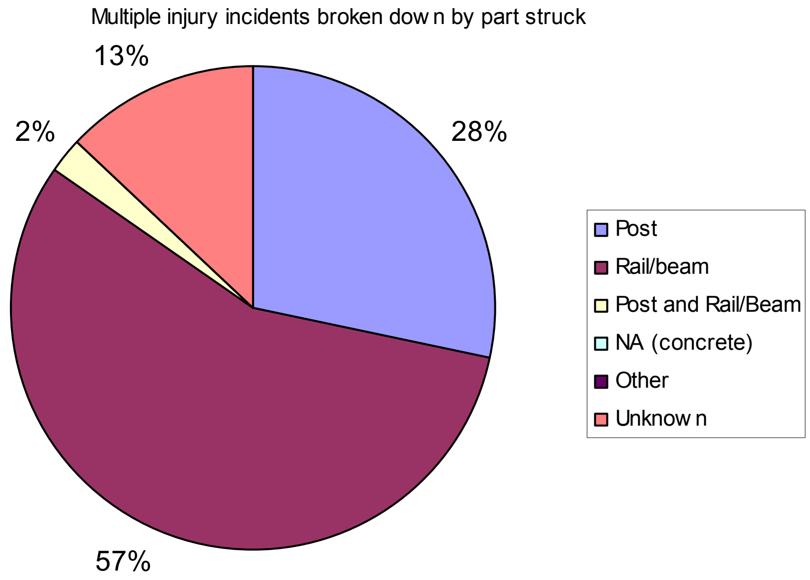


Figure E20: Multiple injuries from pre-impact motion

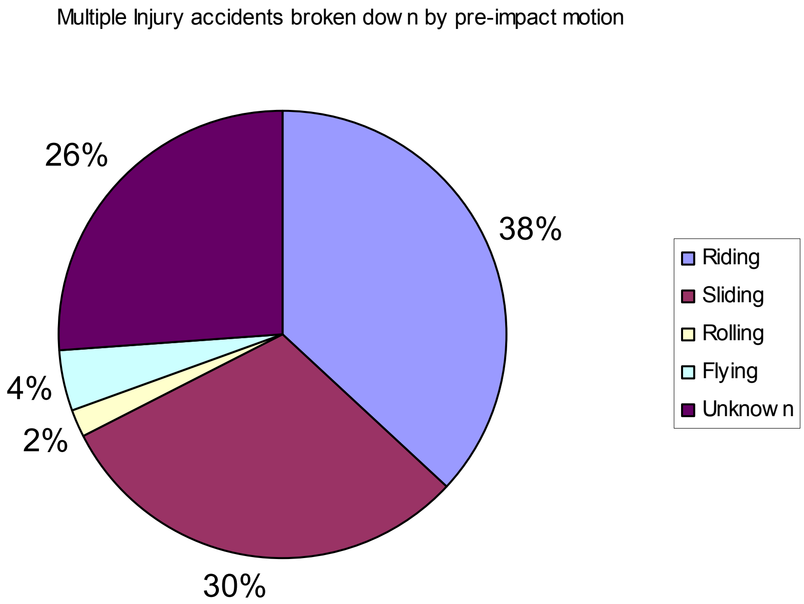


Figure E21 Location of median barrier impacts

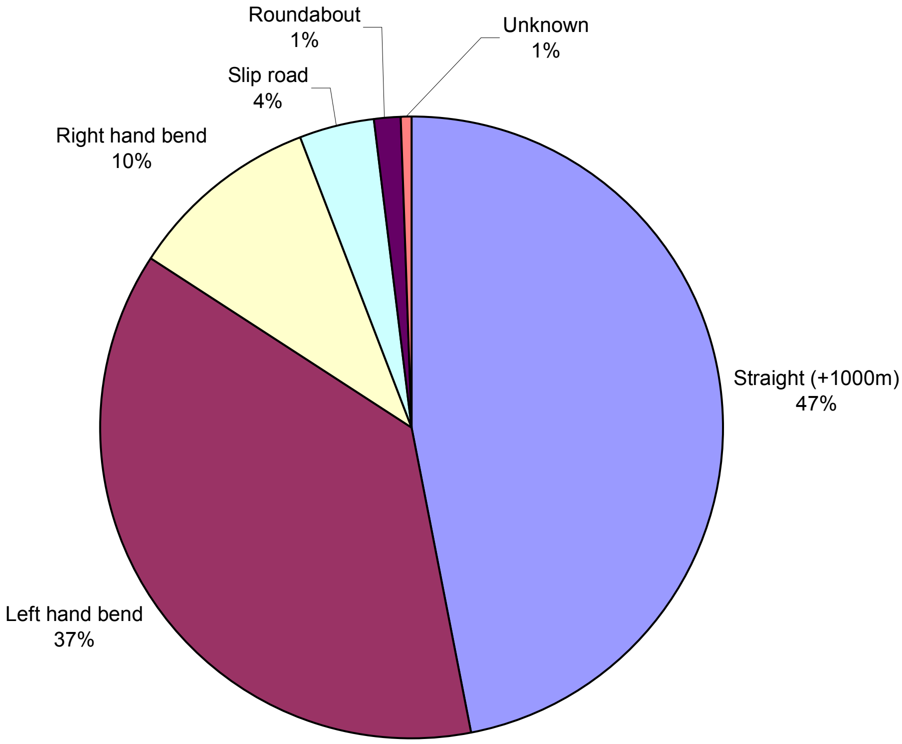


Figure E22 Median left hand bend radius

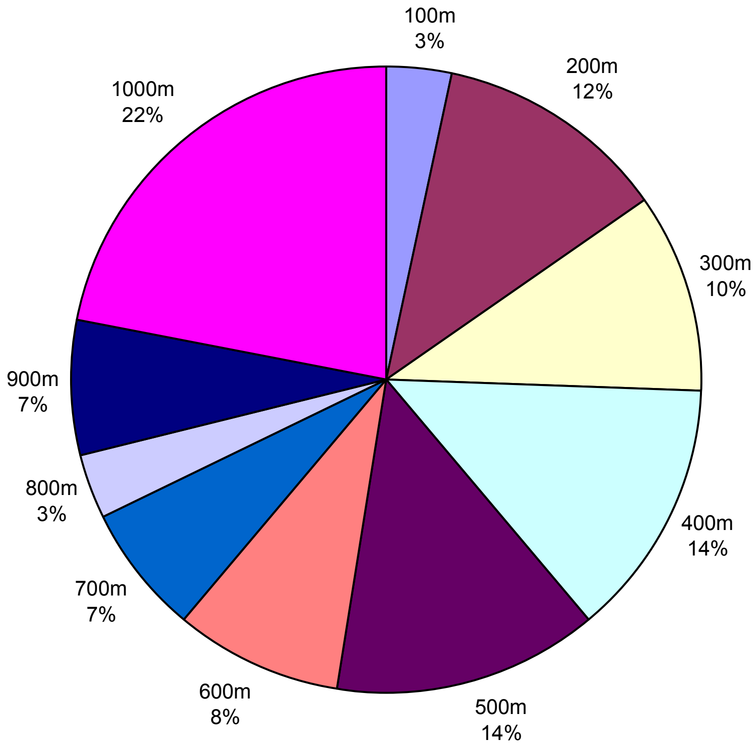


Figure E23 Median right hand bend radius

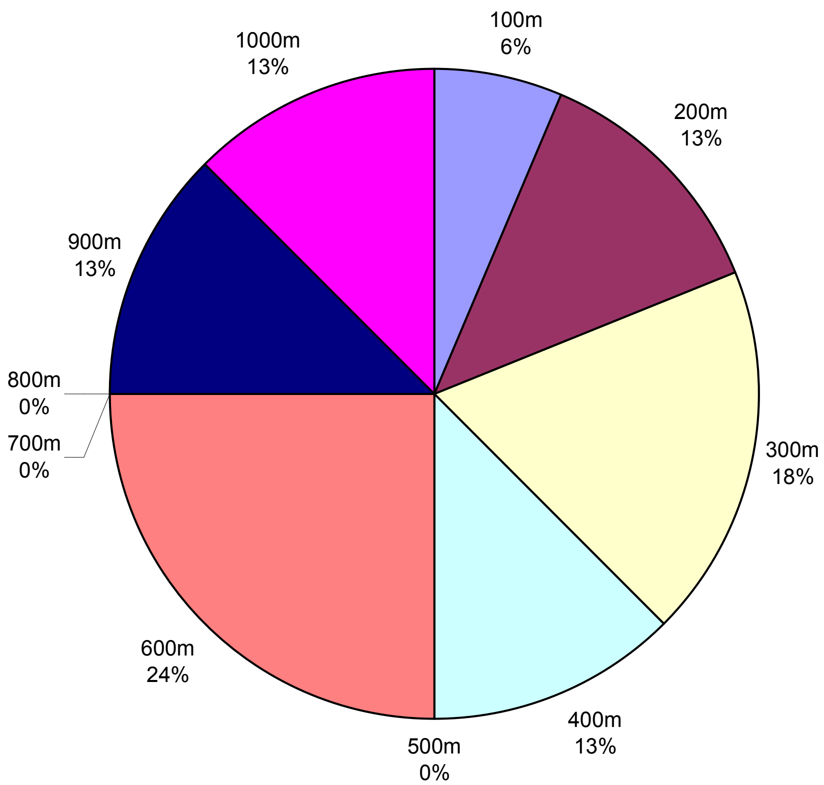


Figure E24 Location of verge barrier impacts

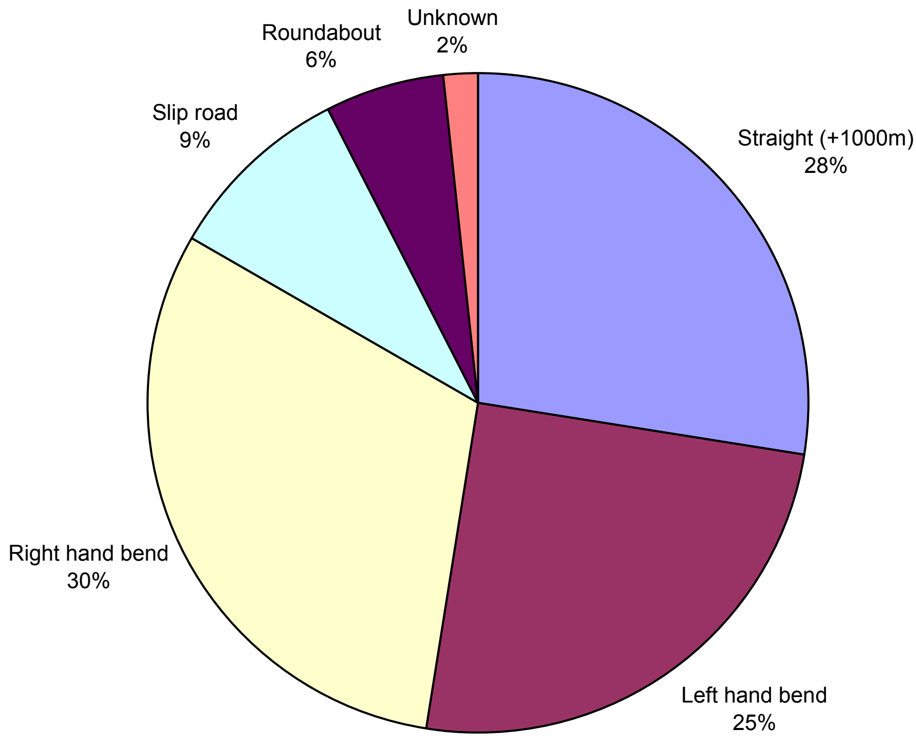


Figure E25 Verge left hand bend radius

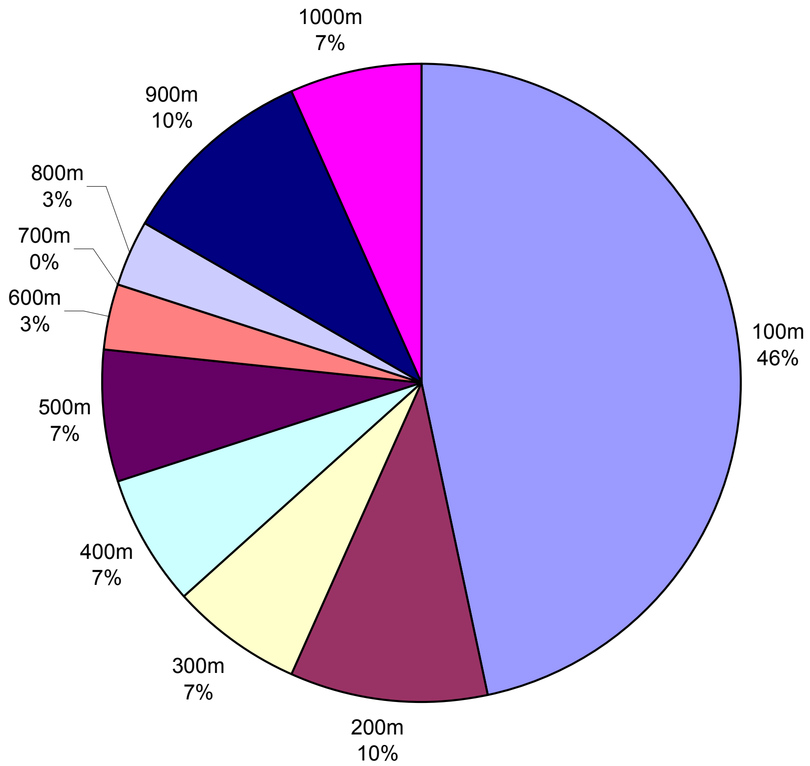
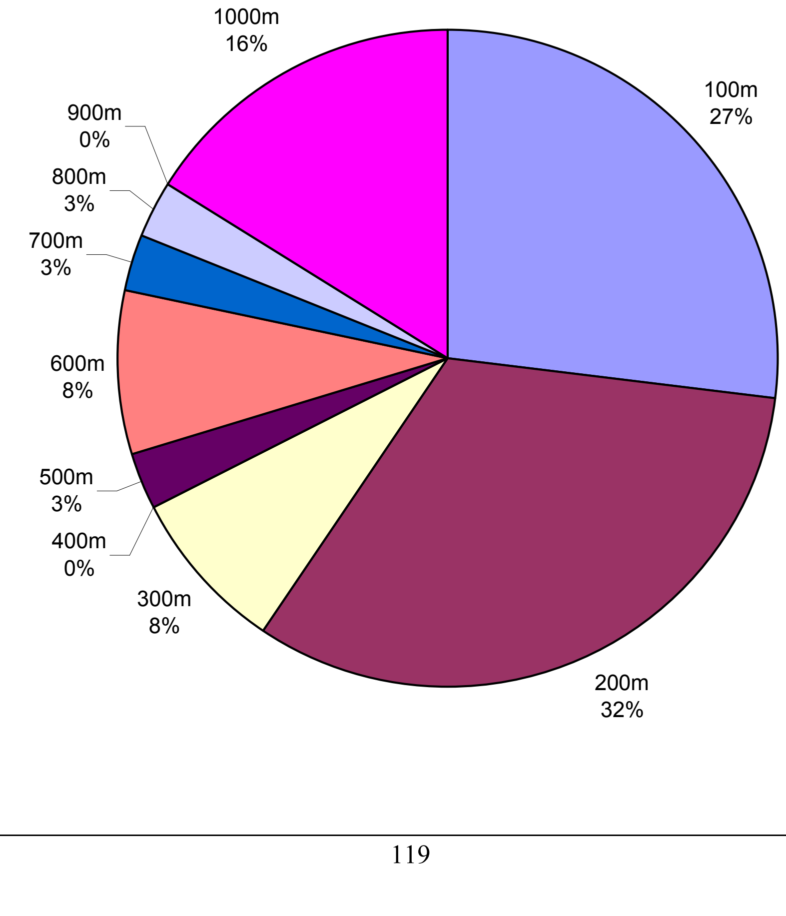


Figure E26 Verge right hand bend radius



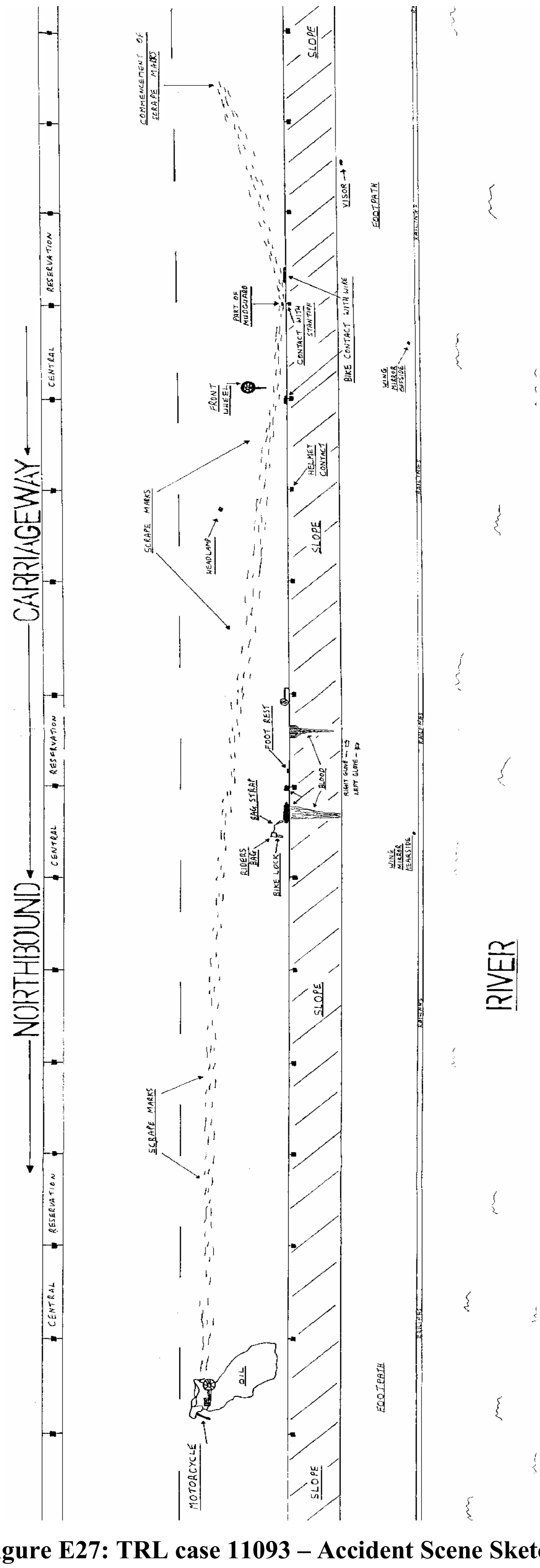


Figure E27: TRL case 11093 – Accident Scene Sketch

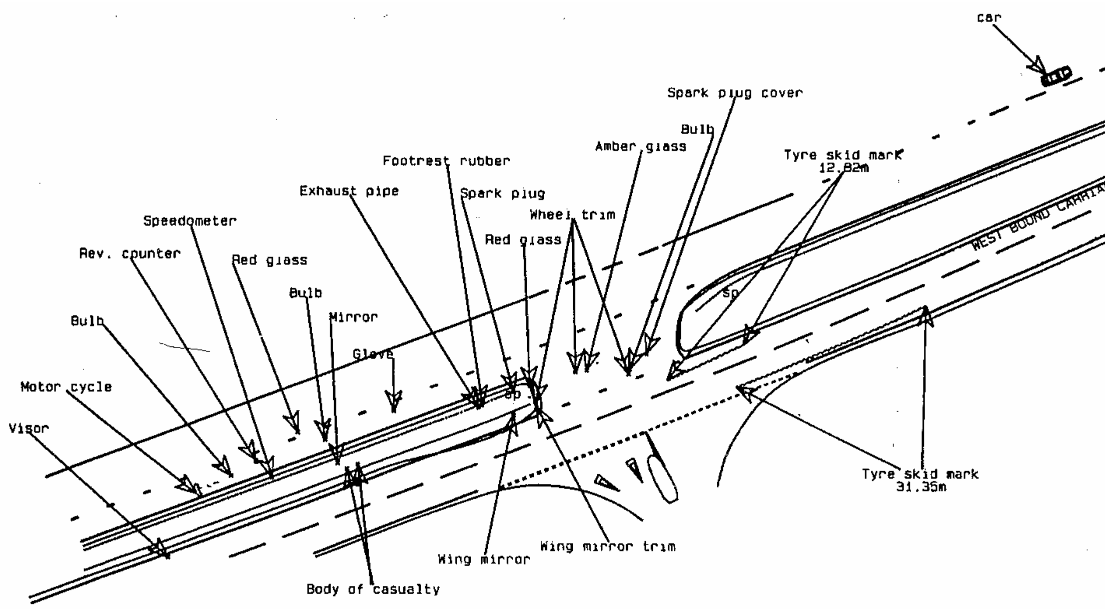


Figure E28: TRL case 21087 – Accident Scene Sketch

Appendix F The Severity of Impacts with Wire Rope Safety Fence in Scotland

Figure F1 Incidents Involving a Motorcyclist striking a Median Safety Barrier on Transport Scotland Roads, 01 Jan 1990 to 31 Dec 2005

Road Name	Section Code	Accident Uid	Accident Code	Easting	Northing	Accident Date	Accident Severity	Vehicle	Vehicle Type	Hit Object Off Cway	Manoeuvres	Barrier Type
M9	15305/65	43499	0667890	311858	675195	03-Jun-90	FATAL	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
A720	11230/20	15286	0680895	327048	666958	06-Jul-95	FATAL	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
A9	10454/61	69861	NE05912	266286	847832	24-Mar-99	FATAL	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	OVERTAKING MOVING VEHICLE ON ITS OFFSIDE	Other
M8	14240/10	115718	AB70105	259589	666325	03-May-01	FATAL	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
M90	15540/11	215598	0002406	308597	722491	19-Jun-05	FATAL	1	MOTORCYCLE OVER 500CC	CENTRAL CRASH BARRIER	OVERTAKING ON NEARSIDE	Other
A78	15110/87	43492	XB70309	223646	674784	04-Sep-97	FATAL	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Wire
A82	10817/22	149623	LA70603	238858	677280	31-Mar-01	FATAL	2	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Wire
A9	10421/15	214753	0001374	292591	710180	19-Mar-05	FATAL	1	MOTORCYCLE OVER 500CC	CENTRAL CRASH BARRIER	GOING AHEAD LEFT HAND BEND	Wire
A90	12374/25	27794	9104127	396254	817088	15-Jun-91	SERIOUS	2	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
A92	14802/55	42210	9402136	313145	688612	23-Aug-94	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
A725	15030/05	43073	QB71812	269200	656700	27-Dec-95	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	CHANGING LANE TO LEFT	Other
M9	10350/50	62914	E837701	281886	687975	02-Apr-99	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	OVERTAKING MOVING VEHICLE ON ITS OFFSIDE	Other
A720	11245/10	81506	0390899	318851	670041	23-Apr-99	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD RIGHT HAND BEND	Other
A8	13855/06	86459	XA70208	235002	673897	11-Aug-99	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD LEFT HAND BEND	Other
A92	14865/72	122412	0101200	328487	704939	01-Apr-01	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD LEFT HAND BEND	Other
M9	10345/50	143844	E201985	287405	684882	20-Aug-02	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
M8	11302/05	162891	0007354	318024	670874	08-Sep-03	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD LEFT HAND BEND	Other
M876	14401/05	41217	BF11775	281209	680478	24-Nov-92	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD RIGHT HAND BEND	Wire
A77	11653/04	116179	UC70605	243545	634943	12-May-01	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Wire
M90	15515/30	136201	0201292	312859	689348	27-Mar-02	SERIOUS	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Wire
A1	10128/50	230216	0003697	378788	669005	30-Apr-05	SERIOUS	1	MOTORCYCLE OVER 125CC AND UP TO 500CC	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Wire
M74	10755/06	140556	4014001	307533	603346	16-Apr-01	SLIGHT	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD LEFT HAND BEND	Other
A90	12240/33	26053	942378E	348951	756349	08-May-94	SLIGHT	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
M8	14270/05	40803	GA70205	255700	664100	08-May-96	SLIGHT	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	CHANGING LANE TO LEFT	Other
M77	11455/05	17289	GC70203	253600	658400	21-Mar-97	SLIGHT	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	OVERTAKING MOVING VEHICLE ON ITS OFFSIDE	Other
A92	14830/05	42364	9801281	329214	695293	15-May-98	SLIGHT	2	MOTOR CYCLE	CENTRAL CRASH BARRIER	STOPPING	Other
A90	12374/26	85441	0002187	396374	818178	22-Jun-00	SLIGHT	2	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
M73	18310/08	118166	ND70407	268621	662114	30-Jul-01	SLIGHT	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD RIGHT HAND BEND	Other
A1	10160/21	161331	0006871	343560	673043	22-Aug-03	SLIGHT	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
A9	10418/07	173207	0001915	289365	708509	26-Mar-04	SLIGHT	1	MOTOR CYCLE	CENTRAL CRASH BARRIER	GOING AHEAD OTHER	Other
M898	18501/00	194244	KB70203	245455	670960	09-Mar-05	SLIGHT	1	MOTORCYCLE OVER 500CC	CENTRAL CRASH BARRIER	OVERTAKING MOVING VEHICLE ON ITS OFFSIDE	Other