The Passive Revolution Guidelines

For Specification and Use of Passively Safe Street Furniture for Rural and Urban roads which are not part of the trunk road system.

DRAFT FOR CONSULTATION

The Passive Revolution's central objective is to promote safer roadsides. Passive safety can greatly reduce the road toll on non-trunk roads where most of our road casualties figures now occur. We understand no-one in the UK has been killed or seriously injured hitting an item of passively safe street furniture or in a related secondary accident where a passively safe item of street furniture breaks away.

We have published these draft guidelines to assist Highway Authorities in making local roads safer. They build the case for passive safety, give advice on how to employ passively safe street furniture and discuss targeting scarce resources to most benefit in safety and economic terms. We also explore measures to reduce casualties from hitting trees. Advice has been provided in the past for trunk roads in TA89/04 and TA89/05 but these guidelines target local authority roads where most 'Killed and Serious Injured' accidents occur.

With any new development there will be worries about risk and with passive safety this has centred on the possibility of frangible posts hitting pedestrians or causing other secondary accidents. This aspect is explored in the guidelines but the real risk is from impacts with conventional street furniture and above all trees as is so clearly demonstrated in the relevant road casualty statistics. The risk is in doing nothing.

We actively seek all comments on these draft guidelines so we can improve the document and tailor it to your needs.

I would like to thank David Milne for his significant contribution to this document.

Andrew Pledge
The Passive Revolution

Contents

Endorsements

It should be a cause for concern that in 2007 nearly 600 people were killed or seriously injured in single vehicle collisions with 'street furniture' Add in those from multiple vehicle collisions (where such 'street furniture' is not counted in the statistics) and the scale of the problem we should be addressing becomes clear.

These guidelines now set out how ALL of us involved in the design, construction and operation of ALL roads in the UK should be actively considering the use of passively safe street furniture.

Previous advice on the use of passively safe street furniture contained in the *Design Manual for Roads and Bridges* may, unfortunately, have led many to have seen passive safety as a trunk road network issue only. Yet, the majority of the single vehicle fatal accidents in the UK occur on local authority A and B class roads.

The Highways Agency and a number of innovative local highway authorities have now established the worth of passively safe street furniture and their efforts should be applauded.

The current road safety targets set by Government require a reduction of 40% in Killed and Seriously Injured casualties by 2010 (set against an average for 1994-98) and in most Highway Authorities this is likely to be achieved. I expect any future targets beyond 2010 to be as ‘challenging’ and for passive safety to be an essential element in any Highway Authority’s 'toolbox'.

The passive revolution and in particular Andrew Pledge and David Milne are to be congratulated on their continuing efforts to play a significant part in stemming the unacceptable cost, both emotionally and monetary, to our communities and economy.

The IHIE firmly supports the work done by The Passive Revolution and we will continue to work closely with them to promote safer roadsides and to establish a 'forgiving' infrastructure and we fully support and commend this new guidance to its members and all local highway authorities.

Anthony Sharp
President IHIE

IHIE | INSTITUTE OF HIGHWAY INCORPORATED ENGINEERS

The UK continues to be a world leader in road safety. Our casualty rates are among the lowest in Europe, and we have a long history of developing and applying the latest techniques to improve the safety of our roads. Local authorities and their partners play a vital part in making our roads as safe as they are. Around 90% of all accidents occur on local roads and the most successful authorities have reduced killed and seriously injured casualties by embracing new ideas and implementing them on their roads.

But the more we achieve the harder it will become to achieve more. It has been demonstrated that whilst the concepts of ‘forgiving roads’ and ‘proactive safety’ are forward thinking approaches they are successful approaches that contribute to minimising the severity of injuries. These new guidelines on passive safety are a welcome addition to a designer's documentation and one that contributes to the concepts previously mentioned.

The Institution of Highways and Transportation, has for many years been seen by the profession as a leading advocate of the importance of the delivery of effective safety management on our public highways for all users. Through its Road Safety Panel, the IHT is committed to delivering and disseminating ‘Good Practice’ in the field of road safety to the profession and it is pleases to commend these guidelines to practitioners.

John Smart BSc C. Eng FIHT MICE
Deputy Chief Executive Director of Technical Affairs
Institution of Highways and Transportation

THE INSTITUTION OF HIGHWAYS & TRANSPORTATION

CHAPTER 1. INTRODUCTION

1.1 These guidelines provide advice for the adoption and selection of the type of passively safe signposts, lighting columns, traffic signal poles, bollards and other passively safe street furniture for non-trunk rural and urban roads. In particular advice is given on crash testing street furniture to EN 12767 and the use of the resultant classifications. The guidelines are advisory and highway authorities should take a conscious decision on whether to adopt them in full or in part. The Passive Revolution believes there are no safety risks but only safety benefits if they are adopted. Advice is given on prioritizing passive safety to those roads where it is likely to be most effective in reducing casualties.

1.2 Table 7 in Appendix A demonstrates A roads have 53% of the fatalities but comprise 12% of the length of the UK network. Table 6 identifies those accidents where use of passively safe street furniture would have saved lives and serious injuries. The statistics in Appendix A make the case for widening the use of passively safe street furniture beyond the trunk road network and especially prioritizing A roads for use of passively safe street furniture clear zones and other similar safety measures.

1.3 Passively safe signposts and lighting columns are now widely used on trunk roads where the speed limit is 50 mph or over. The DMRB Advice Note TA89 'Use of Passively Safe Signposts' effectively legitimised passively safe sign posts in 2004 and its update in 2005 extended coverage to passively safe lighting columns on trunk roads. Passively safe lighting columns and signposts are increasingly the preferred alternative to conventional larger signposts and lighting columns which need to be safeguarded with safety fences on trunk roads. There are now about 20,000 passively safe sign posts and an increasing number of passively safe lighting columns in the UK mainly on trunk roads that meet the test requirements of EN 12767. Installation largely began in 2004 installed after the publication of TA89/04. No deaths or serious injuries having been reported with impacts with this passively safe street furniture. Traditional signposts, lighting columns and utility poles were responsible for 107 deaths and 470 serious injuries in single vehicle accidents in 2007 alone. There will have been further deaths and serious injuries from hitting these items in multiple vehicle accidents which are not included in the statistics. It is becoming increasingly clear that using passively safe signposts and lighting columns saves lives and the main barriers to their broader use are initial cost and inertial resistance to change. There have been no reported deaths or severe injuries reported from impacts with passively safe street furniture in the UK at time of writing. This record should be contrasted with the large number of casualties from hitting conventional lighting columns and signposts on non trunk roads where protective safety fences are rarely provided. Passively safe street furniture can significantly reduce deaths and serious injuries on these roads. The available statistics making the case for passive safety are presented and discussed in Appendix A. Speed affects the severity of accidents but serious injury casualties and deaths with street furniture frequently occur in both urban areas and on rural roads.

1.4 Although passively safe street furniture is usually more expensive than its traditional counterpart, measures like striving for clear zones next to the carriageway and reducing unnecessary signs and roadside clutter can cost little or even save money. A widening range of passively safe lighting columns and signposts is coming to the market often using aluminium or composites which offer a long maintenance free life. For medium sized signs and traffic signals a tubular steel post has been developed which should prove an economical solution. Competition is reducing initial costs and electrical suppliers are developing various electrical isolation systems for the passively safe lighting column and traffic signal market. Passive safety is becoming much more affordable.

1.5 Chapter 4 explains how crash testing is carried out to BS EN 12767 and explains how passively safe products are classified in the light of the results. An understanding of the classification system is necessary when specifying passively safe street furniture

1.6 Chapter 8 discusses electrical safety for passively safe items with a power supply. This is relevant to illuminated signs, lighting columns and traffic lights. Currently a more rapid electrical isolation time of 0.4 seconds is required for passively safe street furniture in an impact because the items breakaway in an impact. This imposes a significant extra cost. Many items of non-passively safe street furniture also break away (but the impact is far more dangerous). We believe there is a need to harmonize electrical isolation requirements to a common standard to avoid unfairly mitigating against passive safety.

1.7 Chapter 9 explores the difficult area of trees and roadside safety. Balancing environmental interests, people's love of trees and roadside safety is emotive and difficult to reconcile. Deaths and serious injuries from impacts with trees are frequent.

1.8 Using passively safe signposts lighting columns and other street furniture will save lives on all roads and reduce serious injuries.

CHAPTER 2. PRIORITIZING ROADS FOR PASSIVE SAFETY

2.1 The Passive Revolution advises that A and B roads should be prioritized for the use of passively safe street furniture as follows:

2.2 Other roads with high traffic volumes commensurate with either A or B roads should be treated as A or B roads respectively. Again roads which suffer from frequent accidents should be reviewed to see if they will benefit from passively safe street furniture. Where an item of street furniture has been responsible for a fatality or a serious injury replacement of the item with a passively safe alternative is a prudent way forward and a review should be undertaken to see if a similar accident is likely to occur elsewhere on the road in question and whether further action is needed.

2.3 While speed must play a significant part in the severity of accidents the statistics available show most fatal single vehicle accidents occur where the speed limit is either 30 mph or 60 mph which matches the common speed limits. Unfortunately these statistics do not identify how the casualties occurred.

2.4 Roads with 20 mph speed limits are relatively rare but report almost no deaths and therefore do not require passively safe street furniture. The statistics are further explored in Appendix A 'Accident Statistics and their relevance for Passively Safe Street Furniture'.

2.5 While these guidelines advise targeting A or B roads

Priority	Type of Road	Reasoning (explored in Appendix A)
1	Rural A roads unless traffic speeds are likely to be under 25 mph because of road geometry or other constraints.	A roads comprise only 12% of the road network but have 53% of fatal single vehicle accident casualties (excluding pedestrian accidents). Using passively safe street furniture is generally more cost effective on rural A roads because there is much less street furniture.
2	Urban A roads unless traffic speeds are likely to be under 25 mph because of speed limits, road geometry or other constraints	Accident rates are as high or higher than rural A roads but mainly because of lighting columns. Using passively safe street furniture will be more expensive per km.
3	Rural B roads unless traffic speeds are likely to be under 25 mph because of road geometry or other constraints.	B roads comprise 8% of the road network and these roads have 20% of fatal single vehicle accidents. Using passively safe street furniture is generally more cost effective on rural B roads rather than urban B roads because there is much less street furniture.
4	Urban B roads unless traffic speeds are likely to be under 25 mph because of road geometry or other constraints.	Accident rates are as high or higher than rural B roads but mainly because of lighting columns. Using passively safe street furniture will be more expensive per km.

Table 1 Priorities for Passive Safety

it is strongly recommended that a highway authority examines casualty records to identify the roads and locations where single accidents are more frequent and to develop their policies in accordance with their own findings. When looking at safety for an individual highway we recommend looking at records for all single vehicle injury accidents because the larger numbers will be statistically more robust.

2.6 It is recommended that passive safe street furniture is specified for all renewals or highway maintenance schemes on A roads and if funds are available on B roads to give a steady upgrade to safety over time and to avoid wasted expenditure from premature renewal of existing street furniture (but where any street furniture is judged to represent a significant risk, earlier or immediate replacement is advisable).

2.7 Passive safety is unlikely to be needed for:

a) Residential roads

b) Roads which are usually lined with parked cars

c) Roads with a 20 mph or lower speed limit

d) Roads where road geometry, road use or other factors effectively limits car speeds to 25 mph or less

e) Country lanes and other roads with low traffic volumes (unless there is a regular accident history or an obvious high risk feature such as a heavy concrete lighting column on the outside of a sharp bend which should be addressed)

2.8 It is recommended that all roadside furniture is recorded on a mapping system for A and B roads (identifying where it is passively safe or not). Ideally all run-off injury accidents should be superimposed on the same system to help identify roads and locations where passive safety and other safety initiatives are likely to be most advantageous.

2.9 When installing any new and replacement street furniture for A and B roads (or if the A or B road is subject to a highway improvement scheme or other major works) passively safe street furniture should generally be specified (unless items are properly protected by a safety barrier). If non-passively safe items of street furniture were to be used the reasoning for the decision (financial or otherwise) should be recorded.

2.10 If passive safety is limited to A and B roads only 20% of the road network will require passively safe street furniture. If passively safe furniture were limited to these A and B roads then 71% of the fatalities with street furniture would be avoided.

CHAPTER 3. GENERAL GUIDANCE ON PASSIVE SAFETY CLEAR ZONES

3.1 A clear zone next to the highway will make a large contribution to roadside safety. Historically the DMRB advised a clear zone of 4.5 metres for trunk roads where speed limits were 50 mph and over. The current advice for trunk roads has been revised in the Design Manual for Roads and Bridges document TD 19/06 and barrier provision/clear zone width is dependent on a risk analysis and this approach may be used if desired although the advice below is based on the simpler 4.5 metre clear zone approach.

3.2 For non-trunk A and B roads a 4.5 metre clear zone is recommended for all hazardous obstructions where verge space is available but all efforts to provide as much of a 4.5 m clear zone width as is reasonably possible are likely to improve safety. Signposts and lighting columns within 4.5 metres of the edge of the carriageway should be passively safe unless behind a barrier (and safely outside the working width of the barrier). In existing urban situations it will often be impossible to provide these clear zones as the footpath is often next to the road and there are often buildings or walls at the back of the footpath.

3.3 Public utilities (electricity and telephone cables) are best if possible below ground. Where posts are necessary, they should be sited if possible 4.5 metres or more from the carriageway for A and B roads.

3.4 Keeping non-passively safe street furniture and all heavy roadside obstructions and potential hazards outside the clear zone for A and B roads may often involve little or no additional costs with only careful planning and should considered for all road schemes.

DESIRABILITY OF ENERGY ABSORBTION IN PASSIVELY SAFE PRODUCTS

3.5 Many but not all passively safe lighting columns and signposts yield and crush at point of impact and absorb energy in the process. If an energy absorbing post or column is of breakaway type (LE or Low Energy and NE or No Energy types) it will not gain significant kinetic energy in an impact and will fall to the ground fairly close to the foundation. The test in BS EN 12767 has no limits on spread of debris but it is advisable to view the high speed BS EN 12767 test video for any product to check the post or column behaves safely and does not rebound at speed off the vehicle. Also energy absorbing posts will safely yield if hit a vehicle in a secondary accident. There is no formal requirement for this characteristic in BS EN 12767. (Chapter 4 discusses EN 12767 classifications in more detail).

SLIP BASED POSTS

3.6 Slip based signposts and lighting columns have been rarely used in the UK. They typically have a slotted base plate which allows the post to slip and break away on impact. They are certainly much safer than traditional non-passively safe lighting columns and signposts but suffer from the following problems:

a) Corrosion can cause lock-up in the slip release mechanism

b) Bolt torques need to be checked at regular intervals
c) They are directional in that the impact has to come from the right direction for slip and breakaway
d) The steel posts used with slip bases are not yielding, can be relatively heavy and may bounce elastically away from the car in the impact raising fears of a secondary accident.
e) If used on embankments the vehicle may be airborne and hit the post at height. Slip bases may lock up when impact occurs at height

Slip based posts have been associated with serious and fatal accidents in Scandinavia and Iceland and are not recommended by The Passive Revolution.

'DEEMED TO COMPLY' STEEL TUBULAR SIGNPOSTS

3.7 Rules for deemed to satisfy steel tubular posts are given in Annex F of EN 12767 and are summarized as follows:

i) Steel tubular posts up to 89 mm diameter and 3.2 mm wall thickness have been crash tested by TRL and classified as 100 NE2.
ii) Post centres for multiple post signs should not be less than 1500 mm (so a car is unlikely to hit more than a single post in an impact).
iii) Steel posts of 76 mm dia and 3.2 mm wall thickness may be used as close as 750 mm

In crash tests these small tubular steel posts flatten under the vehicle and are very unlikely to breakaway. For smaller signs these posts provide an economical and passively safe solution for all locations.

Larger steel thin walled posts tested to EN 12767 are being proposed and may provide economical solutions to passive safety for medium sized signs and traffic lights.

MOTORCYCLE SAFETY AND PASSIVELY SAFE STREET FURNITURE

3.8 Passively safe street furniture may well cause severe injury or death if hit by a motorcyclist at speed. However conventional sign posts or lighting columns with crash barriers are a bigger risk to motorcyclists as the barrier posts are a very dangerous and effectively continuous obstacle for a dismounted and sliding motorcyclist. Signs and lighting columns are only an isolated obstruction and are more likely to be missed. There are products which provide continuous lower level sheeting for barriers screening the posts and allowing motorcyclists to slide along the barrier without hitting the potentially lethal barrier posts. This type of product should be used wherever bikers are most likely to suffer a fall.

RE-USE OF FOUNDATIONS

3.9 Some passively safe signposts, lighting columns and traffic signal poles are designed to be readily replaced after an impact re-using the undamaged foundations. On a busy road network being able to quickly replace lighting columns traffic signal poles or signposts with no foundation works and little, or no, traffic management gives safety and cost advantages and reduces traffic disruption.

CHAPTER 4. RECOMMENDATION FOR USE OF PASSIVELY SAFE STREET FURNITURE

4.1 The recommended classifications for passively safe products to EN 12767 for various uses are given in the Table 2 below:

4.2 Detailed explanations of the test, the classifications and the reasons for their use are given in Appendix B.

4.3 Employing passively safe street furniture to any class in EN 12767 will avoid serious injury in a primary impact. The choice of an NE, LE or HE product may affect the chance of a secondary accident as these classes reflect the slowing of the vehicle in the initial impact and to some extent whether the post or lighting column breaks away in the impact but secondary accidents seem to be rare with no recorded serious casualties recorded in primary or secondary accidents to date in the UK to date for passively street furniture.

4.4 The passive safe products meeting the above classifications in Table 2 are listed on The Passive Revolution website.

CHAPTER 5. SPECIFYING PASSIVELY SAFE SIGNPOSTS TO BS EN 12767 AND TO BS EN 12899 (INCLUDING CE MARKING) AND DESIGNING FOR WIND LOADING

BS EN 12899-1:2007 FIXED, VERTICAL ROAD TRAFFIC SIGNS. FIXED SIGNS

5.1 All highway signposts should be designed to meet the requirements of:

BS EN 12899-1:2007 Fixed, vertical road traffic signs. Fixed signs

The National Annex to the document also advises on designing for UK wind loading.

5.2 Passively safe signposts also then need to comply with the test requirements of BS EN 12767 for passive safety.

CE MARKING

5.3 BS EN 12899 also introduces the ability for signposts to be CE marked to demonstrate compliance with EN12899 and where appropriate with EN 12767. It is anticipated CE marking will become a UK requirement by 2012.

5.4 The passively safe signposts currently on the UK market are mainly NE (No Energy) with one LE (Low Energy) product.

5.5 Passively safe signposts tested to EN 12767 are available in steel, fibre glass composite, carbon fibre com-

Table 2: Summary of Recommendations for Use of EN 12767 Classifications

Passively Safe Street Furniture Item	Speed Limit and recommended passive safety class	Passive Safety Class Recommendations (All occupancy safety levels acceptable)	General Comments
Signposts and Traffic Signal Posts	Max Speed Limit 70 mph or less	100 NE or 100 LE	For signs on more than one post there should in general be at least 1.6 metres clear between adjacent posts unless crash tested in a closer configuration. Height of lower edge of sign plate or signal should be at least 1.8 metres (and sign plate support channels 2 metres) above ground level unless posts crash tested in a different configuration.
	Max Speed Limit 40 mph or less	100NE or 70 NE and 100LE or 70LE	
Lighting Columns unless there are frequent pedestrians or cyclists	Max speed limit 70 mph on motorways and high standard dual carriageways	100 NE	There is evidence that NE products perform better in very high speed impacts.
	Max speed limit 70 mph or less	100 NE or 100 LE	Passively safe NE or LE lighting columns without barriers should not be used in the central reserve as a sheared column could end up in an oncoming carriageway LE lighting columns will retard cars to some extent and can therefore be used where there are concerns about pedestrian or cyclist safety in 40mph speed limits or less. However, HE Lighting columns are still generally preferred in these situations.
	Max speed limit 60mph or less	100 NE, 100 LE or 100 HE	
	Max Speed limit 50mph or less	100 NE, 100 LE or 100 HE	
	Max Speed Limit 40 mph or less	100 NE or 70 NE, 100 LE or 70 LE, 100 HE or 70 HE	
Lighting Columns with presence of frequent pedestrians or cyclists	Max speed limit 60mph or less	100 HE	Whilst LE lighting columns will retard cars to some extent and can therefore be used where there are concerns about pedestrian or cyclist safety. However, HE Lighting columns are still generally preferred in these situations because they are more likely to fully arrest a vehicle.
	Max Speed Limit 40 mph or less	100 HE or 70 HE	

posite and aluminium.

5.6 Some passively safe signposts have moments of resistance of up to 150 KN m and can carry all but the very largest motorway signs.

SITING PASSIVELY SAFE SIGNPOSTS

5.7 Passively safe signposts will be considerably safer than non-passively safe signposts for all locations but because most passively safe signposts breakaway on impact care should be taken at locations where the posts could be displaced into a different or oncoming carriageway. These sensitive locations include:

- central reserves,
- nosings
- splitter islands at roundabouts.

For smaller signs steel posts of less than 89 mm diameter and 3.2 mm wall thickness are passively safe and do not break away but flatten under the vehicle and are recommended for these locations. Again some composite signposts do not breakaway because the longitudinal fibre reinforcement remains intact and these posts are again suitable for these locations. Where breakaway signposts are needed they should be carefully sited to reduce the chance of carrying into an oncoming carriageway in an impact. Where breakaway passively safe signposts are used they should deform or degrade at point of impact and not bounce off the vehicle as demonstrated by very limited carry in the high speed EN12767 crash test.

5.8 Any signposts sited in the working width behind any restraint system must be passively safe so they will yield or bend as the restraint system deflects in the impact.

5.9 Where possible signs should have a minimum clearance to the edge of the hard carriageway of 1.2 metres to reduce the chance of a vehicle impact and replacement costs. Signs should never be closer to the carriageway than the limits given in the Traffic Signs Manual Chapter 1, Part 6.

POST SPACING - NATIONAL ANNEX REQUIREMENTS

5.10 To reduce the chance of a car hitting two posts at the same time for signs mounted on two or more posts there should be a minimum clear distance between the posts of 1.6 metres unless posts have been crash tested to EN 12767 for a closer spacing.

DESIGNING SIGNPOSTS FOR WIND LOADS

5.11 Passively safe signposts have to achieve two contradictory requirements which are difficult to accommodate in the same structure:

a) They need to fail safely in a vehicle impact so as to not endanger the vehicle occupants
b) They need to reliably carry the highest expected wind loads with the appropriate factors of safety to EN12899

The first requirement is satisfied by satisfying the EN 12767 test requirements.

The second will require purchasers of passively safe signposts to satisfy themselves that suitable signpost strengths and stiffnesses are used in design. These should be supported by test results to determine the lower bound characteristic design strength for bending and shear. Wind loading for signs in the UK can be found in the National Annex to BS EN 12899 and advice on foundation design can be found in the Design Manual for Roads and Bridges Document BD94/07 Design of Minor Structures.

5.12 More detailed advice on designing signs and foundations for wind loads is given in Sign Structures Guide published on the web by the Institute of Highway Incorporated Engineers at:

http://www.ihie.org.uk/gateway/traffic-sign-design/resources-1/

CHAPTER 6. USING AND SPECIFYING PASSIVELY LIGHTING COLUMNS, THEIR CLASSIFICATION TO EN 12767, USE OF BS EN 40, CE MARKING

AVAILABILTY AND SOURCES OF INFORMATION FOR LIGHTING COLUMNS

6.1 All lighting columns need to meet the requirements of BS EN 40. BS EN 40 has 7 parts and covers the requirements for lighting columns in steel, aluminium, polymer composites and concrete and also covers load testing and strength from calculation, dimensions and most importantly the requirements for CE marking.

Lighting columns are CE marked to EN 40 and the CE marking or documentation should identify the passive safety class to EN 12767 where passive safety is required.

Passively safe lighting columns are now all CE approved to BS EN40.

There are passively safe lighting columns in steel, aluminium and fibre reinforced composite construction.

Any lighting column located in the working width of a restraint system must be passively safe.

DESIGNING LIGHTING COLUMNS FOR WIND LOADS

6.2 To aid specification of lighting columns to EN 40 and avoid the need to carry out the wind loading and design strength calculations for every specific location BSI committee have published PD 6547:2004 ‘Guidance on the use of BS EN 40-3-1 and BS EN 40-3-3’. This document defines four classes of lighting column in terms of the wind pressures that they can withstand as Light, Medium, Heavy and Extra Heavy. Manufacturers can declare the class of each product, for a given maximum bracket length and luminaire size. Annex A gives the appropriate wind loading class for each administrative area of the UK, up to a maximum altitude. Above this altitude a full calculation to EN 40 must be carried out using the appropriate wind speed data for the location and altitude. PD 6547 also gives guidance on foundation design.

CLASSIFICATION CHOICE FOR LIGHTING COLUMNS

6.3 The choice of recommended passive safety class in Table 2 is discussed in Appendix B

CHAPTER 7. USING AND SPECIFYING PASSIVELY SAFE SIGNAL POLES

7.1 Most traffic signals are mounted on mild steel poles of 114 or 140 mm diameter and 3.2 or 4.0 mm wall thickness. These posts are frequently hit by vehicles and anecdotal evidence suggests few if any people are seriously injured or killed in these collisions. It does however seem unlikely that these poles would achieve an EN 12767 crash testing classification if tested.

7.2 Traffic signal poles need to be easily replaced. Specialist foundation socket arrangements are advantageous in this respect and provide for the necessary power supplies.

7.3 Suitable passively safe traffic signal poles and socket foundations are listed on The Passive Revolution website.

CHAPTER 8. GUIDANCE ON POWER SUPPLIES AND ELECTRICAL SAFETY FOR PASSIVELY SAFE STREET FURNITURE

8.1 Electrical safety requirements are a specialist area and only general advice on electrical isolation and the systems available is included here.

8.2 Lighting columns, traffic lights, illuminated signs and VMS signs all need power supplies. These power supplies are typically the mains voltage of 230 volts. Because passively safe products typically yield or shear in an impact there will always be concern that apparatus, posts or cables become live after an impact and put the public or emergency services at risk after an impact. Electrical safety requirements are addressed in NA 8 of the National Annex to BS EN 12767 but all electrical installations have to comply with BS7671:2008 Requirements for Electrical Installations – IEE Wiring Regulations Seventeenth Edition.

8.2 Cabling systems must not interfere with the passive safety failure mode in an impact. Heavy armoured cables must not tether or interfere with the clean breakaway of a signpost or lighting column. Pullout plugs are often provided to prevent tethering and to provide electrical isolation in an impact.

8.3 Some manufacturers provide isolation plug/socket connections for posts which electrically isolate when a post shears relative to its base plate on impact.

8.4 To provide electrical isolation within the 0.4 second of an impact as required in the National Annex to EN 12767 special electrical solutions have evolved. These include electrical tilt switches, impact sensors and residual current devices. They typically isolate the supply away from the post or lighting column. Suppliers can be found on The Passive Revolution Product list. These products must be installed correctly in accordance with the manufacturer's data sheets by a competent, electrically qualified contractor.

CHAPTER 9. TREES AND ROADSIDE SAFETY – WHAT CAN BE DONE

9.1 In 2007 almost 41% of accidents leaving the carriageway involved a strike with a roadside object (Road Casualties Great Britain 2008). Of these accidents, 3,267 involved a tree strike, resulting in 221 fatal injuries and 794 serious injuries. This is more than the combined number of accidents involving traffic signal poles, road signs and lighting columns. Over 6% of tree collisions involve a fatality compared to the 2% average for road signs, traffic signal poles, lighting columns and crash barriers.

9.2 The figures in Table 3 are for single vehicle accidents and would be higher if tree strike casualties from multiple vehicle accidents were included.

9.3 A motorway accident is four times more likely to result in a fatal injury if it involves a vehicle that strikes a tree, than if it hit a road sign or traffic signal pole (See Table below). Trees are exceptionally dangerous to strike as a result of their size, strength and rigidity.

9.4 While the national road casualties have been reducing year on year for the last five years the number of single vehicle accidents involving tree strikes has remained constant although numbers fell marginally in 2007.

IDENTIFYING AT RISK TREES AND ROADS

9.5 Trees and roads which can represent a risk can be identified by:

a) Use of accident records to identify those stretches of roads where vehicles have left the highway in an accident (recording tree hits only may not give large enough accident figures to identify possible dangers) Accidents and trees close to the carriageway can be plotted on a GIS system.
b) Identifying lengths of road with tree related accidents and then inspecting the road to identify the trees posing a risk. However, tree strikes will often occur where there was no previous history making meaningful targeting difficult
c) Anecdotal evidence from the Police, maintenance operatives or land owners can help identify individual trees/groups of trees that are struck by vehicles with regularity without resulting in personal injury allowing remedial measures to be implemented before a more serious accident occurs.

Factors relevant to prioritization include:

a) Trees with a circumference of more than 500mm equivalent to a diameter of 165mm (measured at 150mm from ground level) are a potential hazard.
b) A roads have the most frequent tree strike casualties
c) Speed limit of the road (ie less chance of fatal injury with lower speed limits).
d) Carriageway type (single, dual carriageway).
e) Tree position in relation to the road and bends.

Table 3: Single Vehicle Accidents by Roadside Object Hit

Object Struck Off Carriageway	Built up roads				Non-built up roads excluding motorways				All Roads including Motorways			
	Fatal	SE*	KSI**	Total	Fatal	SE*	KSI**	Total	Fata l	SE*	KSI**	Total
Tree	*45*	*206*	*251*	*877*	*165*	*554*	*719*	*2,262*	*221*	*794*	*1,015*	*3,267*
Road sign / traffic signal pole	16	78	94	636	23	89	112	631	40	177	217	1,318
Lighting column	35	207	242	1,239	15	58	73	406	52	278	330	1,682
Crash barrier	7	62	69	406	21	149	170	982	50	327	377	2,274

** SE – Serious*
Killed and Seriously Injured
Table adapted from Road Casualties Great Britain 2008

Table 4 below: Risk of injury when hitting a tree when compared with hitting a lighting column or a road sign

	Tree injury risk compared to Road sign / traffic signal pole			Tree injury risk compared to Lighting column		
	Fatal	SE*	KSI**	Fatal	SE*	KSI**
Built up	2.0	1.9	1.9	1.8	1.4	1.5
Non-built up	2.0	1.7	1.8	2.0	1.7	1.8
Motorway	4.3	1.4	1.6	1.6	0.8	0.9

values greater than 1 = number of times more likely to be injured hitting a tree

values less than 1 = number of times less likely to be injured hitting a tree

** SE – Serious*

***KSI – Killed and Seriously Injured*

Reworking of data presented in Road Casualties Great Britain 2008

Table 5 bottom: Numbers of Single Vehicle Accidents with trees 2003 to 2007

Single Vehicle Accidents	Road Type			
Year	Built up	Non-built up	Motorway	Total
2003	961	2,264	138	3,363
2004	974	2,435	156	3,565
2005	967	2,369	109	3,445
2006	932	2,305	131	3,368
2007	877	2,262	128	3,267

Timber faced safety barrier in forest area with optional handrail.

f) Local topography relating to visibility issues.
g) Tree species and numbers (while growth is difficult to predict the maximum size and rate of growth will depend on species to some extent).
h) Tree density (single tree or stand of trees).
i) A tree that has been involved in a fatality or serious injury is an ongoing risk

In practice all the above factors and approaches may be needed to arrive at a suitable policy which identifies at risk trees and at risk roads and targets the worst.

TREE STRIKE CASUALTY PREVENTION

9.6 Possible mitigation measures are:

a) Protecting individual trees or limited groups of trees. It is possible to use special tree barriers or crash cushions. A Highway Care system is illustrated. A system should be suitable for the prevalent vehicle speeds.
b) Safety barriers to prevent vehicles leaving the road. Timber faced barriers are available which have a rustic appearance and are aesthetically appealing in forested areas.

A tree protection system in operation

c) Tree removal – the removal of any trees is a sensitive issue and needs to be in accordance with current legal procedures and environmental considerations. Trees must be cut off at ground level or stumps removed to below ground level as a protruding stump can catch a vehicle with disastrous results
d) Preventative regular coppicing and felling of small trees near the carriageway before they become a danger. Coppicing (with suitable species) can maintain a treed landscape that is very beneficial to wildlife and wild flowers without the threat of larger trees.
e) Regular hedge cutting to prevent sizeable trees forming in the hedgerows.
f) Careful consideration of species ultimate size capability and maintenance requirements and location for any landscaping and planting scheme near the carriageway
g) Lower speed limit for roads with roadside trees (especially if the road has a bad overall accident record)

9.7 Because the problem with existing trees is so severe we recommend serious consideration is given to a roadside tree felling programme for rural A roads combined with extensive landscaping and tree planting initiatives. New trees would be planted or existing trees relocated well away from the carriageway. Such an initiative would need long term planning and a concerted political will. The public would need to be certain that they were gaining trees and an enhanced landscape and not losing the treed appearance of their much loved countryside.

CHAPTER 10. REFERENCES

Designing Safer Roadsides: A Handbook for Highway Engineers
For sale from d.milne@homecall.co.uk. This book offers broad and relevant advice on all aspects of passive safety, barriers, crash cushions and Zero Vision
British Standards:
BS EN 12767:2007 Passive safety of support structures for road equipment. Requirements, classification and test methods
BSEN 12767 refers to EN 1317 for some of the test and classification procedures and requirements:
BS EN 1317-1: 1998: Road restraint systems. Terminology and general criteria for test methods.
BS EN 1317-2: 1998 Road restraint systems. Performance classes, impact test acceptance criteria and test methods for safety barriers
BS EN 12899-1:2007 Fixed, vertical road traffic signs. Fixed signs
TRL Reports (available from TRL):
Implications of using energy absorbing masts to support signs, without protective safety fencing. TRL Project Report PR/SE/VE/637/02 1st August 03;
Passive Safety Tests on Steel Circular Hollow Section Signposts Tests 09NB, 10 NB &12 NB. 1st July 03
DMRB (Design Manual for Roads and Bridges) Documents: BD 94/07 DESIGN OF MINOR STRUCTURES) available from the Highways Agency website.
This document covers the design of minor highway structures and their foundations, including lighting columns cantilever masts for traffic signals and/or speed cameras, CCTV masts, fixed vertical road traffic signs.
IHIE document:
SIGN STRUCTURES GUIDE SUPPORT DESIGN FOR UK TRAFFIC SIGNS TO BS EN 12899-1 is available on The Passive Revolution website.
ROAD CASUALTIES GREAT BRITAIN: 2007 is available at: http://www.dft.gov.uk/pgr/statistics/datatablespublications/accidents/casualtiesgbar/roadcasualtiesgreatbritain20071

APPENDIX A
STATISTICS RELEVANT TO PASSIVE SAFETY

INTRODUCTION

A.1 Available statistics on passive safety are limited but universally favorable. Passive safety has an excellent record in the UK with no serious injuries reported. Any safety failure of a passively safe product would certainly be publicized by the unhappy Highway Authority and by commercial rivals so there is little doubt that this record is correct.

One UK supplier for passively safe signposts provides a free replacement when a passively safe post is hit by a vehicle in exchange for a report of the incident. Over 80 have been hit with no reports of personal injury.

TRL in their report *Implications of using energy absorbing masts to support signs, without protective safety fencing. TRL Project Report PR/SE/VE/637/02 1st August 03* supported the case for passively safe signposts based on their inquiries into Scandinavian experience of passive safety.

CASUALTY DATA

A.2 Casualties from hitting non passively safe traditional street furniture are clearly identified in Table 6 and are derived from *Road Casualties in Great Britain : Main Results 2007* Table 21 for single vehicle accidents. The figures exclude casualties from hitting roadside furniture in multiple vehicle accidents and so underestimate the potential contribution of passive safety.

A.3 It can be seen from table 4 that motorways are very much safer with regard to to single vehicle accidents in spite of the high vehicle speeds. This is because:

i) There are no large trees next to motorways

ii) Large signs and similar obstructions are protected with barrier

iii) Passively safe street furniture is being increasingly used as an alternative to barrier for signs and lighting columns

iv) There is a culture of making roadside verges safe for run-off vehicles on motorways and trunk roads

A.4 Trunk A roads are often dual carriageways and are subject to the same DMRB standards as motorways with protection for roadside hazards. They are likely to be relatively safe for single vehicle off road accidents. Because the statistics in Tables 7 for A roads includes trunk and non-trunk A roads together they underestimate the relative accident risk for non-trunk A roads.

Conclusions from Table 5

A.5 Table 7 demonstrates for single vehicle accidents excluding motorways that:

A roads are 12% of the UK network but have 53% of the single vehicle deaths.

B roads are 8% of the network but have 18% of the single vehicle accidents deaths.

About a quarter of single vehicle deaths occur on built up roads in spite of the lower vehicle speeds and limited length of these roads.

There are about 11,000 km of urban A-roads and 35,000 of rural A-roads. Rural A-roads are 3.3 times as long as urban A roads but only have about 2.5 times the single vehicle fatalities. On this criteria urban A-roads are more dangerous than rural roads. It would be a grave mistake to believe urban A roads do not need passive safety.

Single vehicle accidents by object hit off carriageway: Urban and ruralroads and severity: 2007								
	Lamp Posts		Sign Posts or traffic signals		Telegraph pole or electricity pole		Trees	
Road Type	Deaths	Seriously Injured	Deaths	Seriously Injured	Deaths	Seriously Injured	Deaths	Seriously Injured
Motorways	2	13	1	10	0	0	11	34
Rural Roads	15	58	23	89	7	77	165	554
Urban Roads	35	207	16	78	8	59	45	206

Table 6 Single Vehicle Accidents

SUMMARY

A.6

1) Passively safe street furniture has an excellent safety record with no associated UK deaths or serious injuries to date.
2) Conventional street furniture is responsible for a large number of deaths and these could almost all be avoided if passively safe street furniture were used.
3) 53% of single vehicle deaths on our roads (excluding motorways) occur on A roads which comprise only 12% of the network and are the obvious target for passively safe street furniture.
4) Urban A-roads have proportionally more deaths per kilometre than rural A-roads.
5) The safety record of motorways relative to A-roads with regard to the relative lack of single vehicle accidents with street furniture demonstrates that significant safety gains can be readily made by using passively safe street furniture on the rest of the road network.

APPENDIX B
CRASH TESTING AND CLASSIFICATIONS TO BS EN12767:2006 AND THEIR USES.

B.1 BS EN 12767 is used to evaluate whether items of street furniture (and in particular their supports) are unlikely to cause injury to vehicle occupants in a crash when hit at speed. Signposts, traffic light poles, lighting columns and traffic bollards have been crash tested and classified to this pan-European standard. Products tested to the standard have also been used for masts to mount roadside cameras. Any roadside equipment can be crash tested in its field configuration to the standard to see if it is passively safe.

B.2 There have been no reported deaths or serious injuries in accidents with passively safe street furniture meeting any of the classes to BSEN 12767:2007 in the UK to date. In Europe passively safe street furniture generally has an excellent safety record but there have been casualties with slip based posts and also with HE lighting columns when used on motorways.

B.3 BSEN 12767:2007 contains:

a) A detailed protocol for the crash tests including the

Table 7: Single Vehicle Accidents According to Road Type

	Urban Roads		Ruralroads		Urban and Ruralroads (not m/ways)				
Road Classification	Fatalities	% of total fatalities	Fatalities	% of total fatalities	Fatalities	% of total fatalities	Overall Length KM	Fatalities/ 1000KM	% of network
A roads	92	43%	235	57%	327	**53%**	48164	**6.79**	**12%**
B roads	42	20%	70	17%	112	**18%**	31216	**3.59**	**8%**
Other roads	79	37%	104	25%	183	**29%**	314392	**0.58**	**80%**
Total	**213**	**100%**	**409**	**100%**	**622**	**100%**	**393772**	**1.58**	**100%**

Notes for Table 7

a) A Roads include trunk A-roads

b) Motorways are excluded from the above figures

c) Pedestrians are excluded

vehicles to be used, the instrumentation and measurement requirements (brief details are given below).

b) A classification system which uses the results to classify the item tested into one of a number of classes for speed, energy absorption and safety level

c) The UK National Annex to BSEN12767 contains detailed advice on how to use passively safe street furniture in the UK. In particular the National Annex (NA) gives rules for what classification of passively safe street furniture is suitable for which location. In general these guidelines agree with the advice in the National Annex. Where the guidelines differ from the NA we have given our reasons for the difference of opinion.

BSEN 12767:2007 TEST DETAILS

B.4 It is advisable to read BSEN 12767 for a full account of the test and the test classifications

B.5 To achieve an EN 12767 classification a product has to successfully undergo two crash tests, a low speed test at 35 kph and a high speed test (50 kph, 70 kph or 100 kph dependant on the classification sought). The tests are done with a light 900 kg car (with specified crush characteristics). Typical calibrated test cars are Ford Fiestas, Suzuki Swifts and Peugeot 205's. Accelerations are carefully measured throughout the crash in 3 dimensions and high speed films of the impact made.

B.6 To be a successful test the vehicle must suffer no dangerous intrusion of the passenger compartment, must not roll or pitch beyond 45 degrees and the accelerations in the vehicle are used to determine the 'occupant safety levels' (values of 1 to 3 with 3 being the safest occupant safety level safety level) by using THIV (Theoretical Head Impact Velocity) and ASI (Acceleration Severity Index) values calculated from the accelerometer results in accordance with EN 1317-1 where:

ASI is a value from the three dimensional accelerations measured in the impact with the limits aimed to reflect human tolerances

and

THIV is again calculated according to EN 1317-1 from the accelerations measured in the impact and represents the velocity a 'free head' would hit the inside of the vehicle as the vehicle is slowed in the impact with again the limits selected to reflect human tolerances.

There is an additional occupant safety level 4 for items such as plastic bollards with a simpler test where only speed pre and post impact is measured. Items tested to this level are exceptionally safe in an impact.

The National Annex to BSEN12767 accepts any of the occupant safety levels as being acceptable.

B.7 Passively safe street furniture does not all behave in the same way in an impact. There are two main principle ways of achieving passive safety and these are:

a) Breaking or shearing away at the base

and

b) Flattening, yielding distorting or degrading as the vehicle hits absorbing energy from the vehicle and not bringing it to a violent stop

Products can use both means to limit impact forces.

B.8 Important properties for passively safety are:

a) Light weight reduces which reduces dynamic impact forces (a heavy VMS sign or a heavy battery for a Vehicle Actuated Sign would not be passively safe even when mounted on passively safe posts)

b) Ability to absorb energy. Even where the prime mode of failure is by shear or breakaway it is important the actual structure absorbs energy by yield for a metal or by progressive material degradation for a composite so the column or signpost does not bounce away from the vehicle in an impact creating a possibility for a secondary accident. Energy absorbing products are inherently more failsafe than more rigid products with a single failure point.

Passively safe street lighting columns, signposts and traffic signal poles can be of aluminium, steel, or composite glass or carbon fibre construction.

CLASSIFICATION OF PASSIVELY SAFE STREET FURNITURE TO EN 12767

B.9 A typical classification to BS EN 12767 could be 100 NE 2 where

100 means the item has been crash tested at 100kph (and at the 35 kph mandatory test speed)

NE means the item has lost minimal speed in the impact (see table 8)

2 means the item has an occupant safety level of 2 based on ASI and THIV values.

Products can be rated for 3 speeds - 50 kph 70 kph and 100 kph. In practice products are only rated at 100 kph (100 kph high speed crash test and a mandatory 35 kph crash test) and at 70 kph (70 kph high speed crash test and a mandatory 35 kph crash test)

The products are divided into three classes dependant on the speed loss of the car in the impact in the high speed test NE or No Energy, LE or Low Energy or HE or High Energy. The requirements are given in Table 1 below.In practice all passively safe products (even NE products) are safer if they yield (or for composites degrade) at

Table 8 Exit Speed Requirements for NE, LE and HE ratings

NE or No Energy	The car loses minimal speed in the impact. 70 kph rating - exit speed is between 30 kph and 70 kph in the 70 kph test 100 kph rating – exit speed is between 70kph and 100 kph in a 100kph test Currently all passively safe signposts, all traffic light poles and some lighting columns and are NE rated
LE or Low Energy	The car loses some considerable speed in an impact. 70 kph rating - exit speed is between 5 kph and 30 kph in the 70 kph test 100 kph rating – exit speed 50kph and 70 kph in a 100kph impact Some lighting columns are LE rated
HE or High Energy	The car is significantly arrested or slowed in an impact 70 kph rating - exit speed is less than 4 kph (and may well be totally halted) 100 kph rating – exit speed is 50 kph or less These lighting columns use their length to achieve the necessary retardation by bending round and flattening under the vehicle bringing it to a relatively gradual halt. The lighting columns remain embedded in the ground and do not shear or break free. The ability to halt or almost halt a vehicle at medium speeds make them very suitable for town use to safeguard pedestrians. Some lighting columns are HE rated Only lighting columns have the length needed to give the gradual retardation needed achieve an HE rating.

point of impact as this prevents the passively safe furniture item 'bouncing' off the impacting car. A criticism made of steel slip based posts is they can bounce elastically off the impacting vehicle on impact at speed and then carry some distance because they do not absorb energy.

EN 12767 TEST SPEEDS AND THE NATIONAL ANNEX RECOMMENDATIONS

B.10 The National Annex to BS EN 12767 in NA.2.1 advises that products should be tested at 70 kph where speed limits are less than 40mph. The Passive Revolution believe there is no evidence that products tested at 100 kph and the mandatory 35 kph fail to perform safely at speeds below 40 mph. Products tested at 100 kph are thought suitable for all locations in Scandinavia. We are of the view that NE passively safe signposts tested at 100 kph (and the 35 kph mandatory test) remain suitable for all speed limits and our recommendations in Table 2 reflect this.

CHOICE OF PERFORMANCE CLASSES FOR LIGHTING COLUMNS

B.11 Table 2 'Summary of Recommendations for Use of EN 12767 Classifications' in Chapter 2 summarizes the recommended performance classes for various roads However any lighting column that is passively safe to a class in EN 12767 will be much safer than a non-passively safe lighting column. The choice of class NE, LE or HE could theoretically affect the chance of a secondary accident at locations where there are likely to be pedestrians or cyclists and there may be other safety reasons to arrest the vehicle in an impact but the primary risk will always be the initial impact. Going passively safe will undoubtably save lives. The recommendations below on safety class in Table 2 are based on consideration of what happens to the column and the reduction of vehicle speed in the impact but there appears to be currently little evidence to support (or contradict) the recommendations below. All products will almost certainly eliminate death or serious injury in the primary impact but the choice of NE LE and HE may be relevant to the very low risk of a subsequent secondary accident.

HE LIGHTING COLUMNS

B.12 In an impact HE columns typically wrap over the vehicle on the impact and then flatten and distort and bring the vehicle to a relatively gradual halt. This has the following advantages:

a) The column is very unlikely to hit a pedestrian or cyclist as it does not shear off in impact.
b) Light vehicles are likely to be fully arrested if the vehicle speed is less than 70 kph (but lorries and heavy vehicles will slow much less). Stopping the vehicle prevents secondary impacts safeguarding both vehicle occupants and bystanders.
c) Pedestrians are safer as the vehicle is arrested and the lighting column is not displaced.

In 100 kph tests the column has hit the car roof hard enough to cause significant deformation in some HE 100 kph EN 12767 tests. As a result HE columns are only recommended where the speed limit is 60 mph or less. This is however not a severe limitation as most lighting columns will be located in urban areas where speeds are 60 mph or less.

While HE lighting columns can arrest or almost arrest a vehicle if the vehicle speed is less than 70 kph (and slow the vehicle at higher speeds) HE lighting columns cannot protect pedestrians where the errant vehicle does not hit a lighting column so HE columns are an uncertain safety barrier.

HE lighting columns are not recommended for speed limits of 60 mph or more because:

a) In 100 kph tests to EN 12767 with HE lighting columns vehicles have suffered roof deformations as the lighting column bends over the vehicle in the initial impact. These deformations may be worse at higher speeds
a) At higher speeds some HE columns may not be able to absorb enough energy to halt a vehicle
a) Impact severity can increase with speed for HE lighting columns

NE COLUMNS

B.13 NE columns (and other NE products) will usually perform well in high speed impacts and NE lighting columns are recommended for 70 mph motorways and dual carriageways.

NE columns are not recommended for areas with frequent pedestrians and cyclists as they may be hit by a falling lighting column or the ongoing vehicle following an impact as the vehicle will be little slowed

NE products will have lower ASI and THIV test limits than HE or LE products for a given "occupant safety level" which reflects the reduced impact accelerations achievable with NE products. NE products will be safer for the same occupant safety level than an NE or LE product.

NE lighting columns breakaway at or near the base with the vehicle typically passing under the column which then falls close to its original position. In low speed tests the column can fall away from the vehicle. As for any passively safe product it is important to view the crash test footage to see the product behaves safely and does not rebound off the vehicle in the impact.

It is desirable that the column will yield (or degrade if a composite) wherever it is hit. Such deformation makes the product safer if it is hit by another vehicle in a secondary accident.

LE COLUMNS

B.14 Performance lies between NE and NE columns. They still typically break away in an impact but some vehicle speed is lost.

They are recommended for all situations except 70 mph dual carriageways and motorways where we recommend NE columns.

Where there are frequent pedestrians or cyclists HE may be preferred because in an impact LE columns are more likely to break away break away and the vehicle is less likely to be fully arrested.

APPENDIX C
SUBMISSION OF COMMENTS ON THE DRAFT GUIDELINES

Comments on the guidelines need to be submitted by e-mail by 15th September to both:
Andrew Pledge
andrew.pledge@thepassiverevolution.co.uk
and David Milne
d.milne@homecall.co.uk
The draft guidelines will be displayed on http://www.thepassiverevolution.co.uk
We plan to review the comments and publish the final guidelines on The Passive Revolution website.
The intention is to update as needed after that date.

The Passive Revolution would like to thank
Mott MacDonald, Highway Care, TEC and
David Milne for their much appreciated assistance
in developing and publishing this document.