Enhancing Road Safety

The Role of Passive Safety Signposts

Contents

When And Why Use Passive Safety Posts?

We refer to the practice of taking measures to reduce the consequences of accidents as passive safety. This includes passive safety features of vehicles, but also measures taken on the roadside, such as using passively safe roadside products.

‘Passively safe’ crash friendly roadside products, such as supporting structures for signs, lighting and other roadside items, serve the purpose of lowering the risk of personal injury in case a vehicle collides with them. The use of passively safe lighting columns and signposts is becoming increasing common on both National Highways and local authority rural roads.

They are particularly suitable where it would be difficult to use a safety barrier, or where the safety barrier itself could pose a hazard, for example at a nosing or on a roundabout splitter island. Passively safe signposts are constructed of either aluminium, steel or from composite material, such as glass reinforced plastic (GRP).

A Brief History Of Passive Safety

In the latest available figures from the DfT, published in 2019 [see Figure 1], there were 752 deaths and 10,657 serious injuries on all roads resulting from vehicles leaving the carriageway and colliding with a roadside object. (Includes figures where the object hit was not reported or unknown.) Even one death is too many, which highlights the importance of any measures taken to reduce the risk of fatalities and injuries.

RAS10001

Reported accidents by speed limit, road class and severity, Great Britain, 2019

Number/percentage change compared to 2018

Type of road	Fatal		Serious (unadjusted)		Serious (adjusted)		Slight (unadjusted)		Slight (adjusted)		All accidents		Road traffic[1]
	Number	% change	Number	% change	Number	% change	Number	% change	Number	% change	Number	% change	% change
Motorway	100	9	664	-3	792	-10	3,366	-11	3,238	-12	4,130	-10	2
Built-up roads													
20 mph[2]	55	12	1,858	7	2,083	1	9,829	11	9,604	13	11,742	10	..
30 mph	543	-4	12,988	0	15,066	-4	55,703	-7	53,625	-7	69,234	-6	..
40 mph	184	10	2,106	0	2,443	-3	7,662	-3	7,325	-3	9,952	-2	..
All built-up roads[6]	782	0	16,952	1	19,592	-4	73,194	-4	70,554	-4	90,928	-3	..
Non built-up roads													
50 mph	111	-17	958	-3	1,125	-8	3,363	-8	3,196	-9	4,432	-7	..
60 mph	548	1	4,076	3	4,824	-3	9,776	-10	9,028	-9	14,400	-6	..
70 mph	117	-2	767	7	884	2	2,682	-9	2,565	-8	3,566	-6	..
All non built-up roads[6]	776	-2	5,801	3	6,832	-3	15,821	-9	14,790	-9	22,398	-6	..
Major roads[3]	1,009	-2	10,992	1	12,700	-4	44,471	-4	42,763	-4	56,472	-3	1
Minor roads[4]	649	1	12,430	1	14,522	-4	47,985	-7	45,893	-7	61,064	-5	3
All roads[5]	1,658	-1	23,422	1	27,222	-4	92,456	-5	88,656	-5	117,536	-4	2

1 Motor vehicle traffic only.

2 Some of the year-on-year changes in this table will relate to increases / decreases in the length of the road with the given speed limit. This is particularly the case with roads limited to 20 mph which are likely to have increased significantly in recent years. The Department is considering the best way to measure the change in the amount of roads limited to 20 mph.

3 Motorways, A(M) and A roads (ie motorways, trunk and principal roads).

4 B, C and unclassified roads (ie other roads).

5 Includes cases where either road class or speed limit are not reported.

6 Excludes unknown speed limit

Source: STATS19, DfT National Road Traffic Survey

Figures for serious and slight injuries are as reported by police. Since 2016, changes in severity reporting systems for a large number of police forces mean that serious injury figures, and to a lesser extent slight injuries, are not comparable with earlier years. Adjustments to account for the change have been produced. More information on the change and the adjustment process is available in the 2019 annual report.

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Notes & Definitions

The figures in this table are National Statistics

Adjusted figures are experimental statistics

Last updated: 30 September 2020

Next update: September 2021

Figure 1: – Reported single vehicle accidents by object hit off carriageway, road class and severity, Great Britain, 2019 (DfT statistics)

The subject has been considered important in the UK since the early 1960s and in the following decades research was directed towards developing passively safe lighting columns. However, their use only became widespread once new materials became available in the late 1990s.

In 2000, a European Standard (BS EN 12767) was published, providing means of testing and assessing the level of passive safety offered by road equipment support structures. The standard specifies performance requirements and defines levels, in passive safety terms, which are intended to reduce the severity of injury to the occupants of vehicles impacting with permanent road equipment support structures.

Initiatives such as Vision Zero, Toward Zero Deaths, Road to Zero and now The Safe System Approach, have also contributed to the increased popularity of passively safe, crash friendly supports. The system, that requires a culture that places safety first and foremost in road system investment decisions, originated from Sweden and Netherlands, and has been adopted by other countries, achieving a significant reduction in fatalities.

[see Figure 2] The main principle of the Safe System Approach is that it is unacceptable to allow deaths and serious injuries to occur on the roads. It also acknowledges that road users are human beings prone to making mistakes, leading to crashes. Therefore, the goal is to eliminate fatal and serious injuries, as well as trying to eliminate crashes by traditional road safety methods such as Engineering, Education and Enforcement.

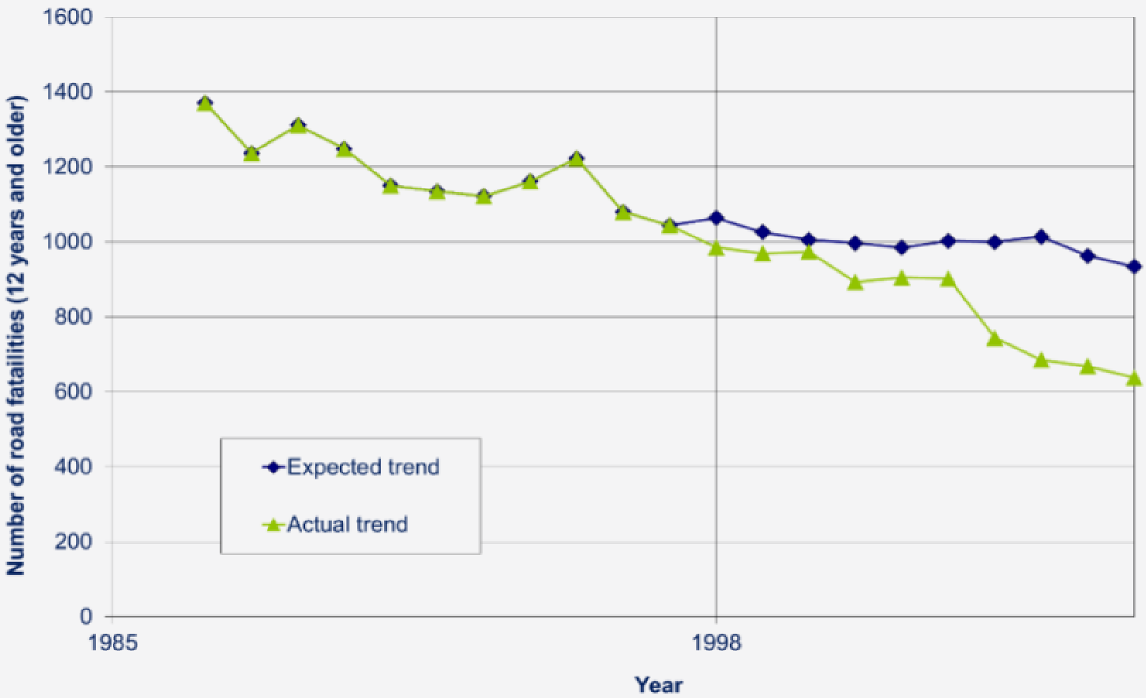

Figure 2: – Calculated reduction in the number of road deaths in the Netherlands due to implementation of the national Safe System approach compared to outcomes without the interventions taken (adopted from Weijermars & Wegman, 2011).

In addition to the risk to human life, road crashes costs usually represent around 1-3% of a country's GDP. As the costs of the prevention of accidents are usually substantially less than the cost of collisions occurring, making roads and roadsides, vehicles and speeds more forgiving will contribute to economic savings for a society.

An Introduction To The Passive Testing Standard, BS EN 12767:2019

BS EN 12767:2019 is a comprehensive guide to the passive safety of support structures for road equipment.

The most recent update was released on 22nd September 2023, and contains an updated UK Annexe. This standard is the latest in the series, reflecting the most recent advancements and best practices in the field.

It provides detailed requirements and test methods to ensure the highest level of safety in the design, installation, and maintenance of road equipment support structures.

The standard considers:

Two kinds of test inputs:

→ Three speed classes (50, 70 and 100 km/h), depending upon where the structures are being located;

→ Three backfill types (standard aggregates(S), special (X) and Rigid (R))

Five kinds of test outcomes:

→ Three energy absorption classes: high energy absorbing (HE), low energy absorbing (LE) and non-energy absorbing (NE), determined by the exit or residual speed of the vehicle after impacting the passive product;

→ Five occupant safety classes (from A to E);

→ Two mechanisms of collapse for support structures (Separation mode (SE) and No separation collapse mode (NS));

→ Three direction classes (single directional (SD), bi-directional (BD) and multi-directional (MD));

→ Two classes of risk of roof indentation (0 or 1).

The performance class of each tested support structure are expressed as a combination of the above factors, in a specific sequence, e.g. 100-HE-A-S-SE-MD-1 or 70-LE-B-R-SE-SD-0.

How Do Passive Posts Reduce The Risk Of Injury Of Vehicle Occupants?

When a road crash occurs, the vehicle and its passengers quickly decelerate, and force is exerted on the vehicle. Modern cars have safety features that absorb kinetic energy in collisions, such as seat belts, air bags and crumple zones, but this is not always enough to prevent death or serious injury to the vehicle occupants.

Colliding with a heavier stationary object such as a traditional lamp post or signpost, which is not crash-protected, could have disastrous consequences for the vehicle and its passengers.

If the force on impact is not sufficient to move the object, it will send a considerable force back to the vehicle. Whereas a light object, which moves easily on impact, will absorb some of the vehicle's kinetic energy, thereby limiting the severity of the crash.

This is the principle on which passive traffic posts have been developed to minimise the damage caused to a vehicle and its occupants in the event of a crash. As referred to earlier in the introduction of the BS EN 12767:2019 standard, there are two mechanisms of collapse for support structures, which indicates how the pole behaves in the event of a collision: separation mode (SE) where the post breaks or shears away, and no separation collapse mode (NS) which normally involves the post bending. The collapse mode of an object can be different for a low speed than for a high speed. The no separation mode is associated with a lower risk of the falling structure causing any issues, but technically not possible with some energy absorption categories (NE). In some cases, shearing of the pole (SE) is necessary to achieve the correct performance class.

Any post size less than the size stated below are deemed to be passive in a single leg installation. [see Table 1]

Table K.1 — Single legged post supports

Description	Material and grade	Tested height (m) Height x width of sign (m) Mounting height to underside (m)	Speed class	Energy absorption category	Occupant safety class	Backfill	Collapse Mode	Direction
Circular hollow section steel posts of equal or less than 89 mm nominal diameter and 3,2 mm nominal wall thickness[a,b,c,d,e]	Steel S355J2H	3,6 1,5 × 1,15 2,1	100	NE	C	S, X and R	SE	MD

[a] Full details of the tests and conclusions are available in the report PR/SE/726/03: Passive safety tests on steel circular hollow section sign posts – TRL UK.

[b] Results are valid also for supports made of circular hollow steel or aluminium sections of the same or smaller diameter and which have a lower bending and shear capacity than tested (see Annex G).

[c] If two posts, perpendicular to the carriageway, are used for one sign:
— Where post clear opening L are less than 1,5 m, post dimensions shall not exceed 76 mm diameter and 3,2 mm wall thickness;
— Where post clear opening L are 1,5 m or greater, post dimensions shall not exceed 89 mm diameter and 3,2 mm wall thickness.
— (for definition of the clear opening L see 7.3.3)

[d] The results are not applicable to braced structures.

[e] All backfill types are deemed to comply, because the crash test was conducted in Rigid type R and any alternative will always be equal or less rigid.

Table 1: – Sizes of single legged post supports considered passive

Considerations For The Placement Of Passive Posts

Typically, the main benefit of using a passive post is that it negates the need for a safety barrier where there are no other reasons to install safety barriers, significantly reducing costs. However, there are a number of considerations that need to be taken into account when specifying passive posts.

When selecting passive posts with different energy absorption classes, the safety of the occupants of the colliding vehicle, as well as the safety of other road users need to be considered. The safest post option for a particular road situation depends on the permitted speed, the presence of other obstacles/ objects and the possible presence of third parties.

Depending upon the energy absorption rating the risk of impacting other street furniture or structures needs to be considered. For example, if a non-energy absorbing (NE) passive post is specified then no safety barrier protection is required. However, given that an impacting vehicle could leave the passive mast at a speed of over 70kph consideration needs to be given to any impact risk behind the mast, this may dictate that a safety barrier is still required albeit not for the passive post. Passive posts work well where there is a clear "run off" area beside the road.

At locations where there is a secondary danger behind the post, and it is not possible or desirable to use a crash barrier, high energy absorbing (HE) signposts may be specified. Low energy absorbing (LE) signposts are often chosen as a compromise solution in certain situations.

Andrew Pledge, Managing Director of Passive Safety UK commented on making the right choice and specifying the right solution for each scenario: "Passively safe structures play a key role in making the road environment more forgiving and are a key component of a safe system approach. It is important that designers are aware of and understand the requirements of the passive safety standard and all available guidance. This will permit them to design, specify and implement appropriate road infrastructure to ensure that the positive safety benefits are achieved."

Pledge also highlighted the importance of educating the industry: "Passive Safety UK also welcomes initiatives that inform designers and specifiers of the design characteristics of the available products, so that they may educate themselves regarding their performance. Understanding how each of these products work greatly influences the right choice in their specification."

Standard Post Impact

Passive Safety Post Impact

Are Passive Posts Safe?

Passive posts are designed to increase that safety of road users, by reducing the risk of fatality or serious injury to the occupants of the vehicle colliding with them.

However, from time to time, concerns emerge about the safety of use of passive posts. A common concern relates to the risk of secondary impact on other road users, especially in case of passive posts with the separation mode (SE) collapse mechanism. As the Sign Structures Guide 2021 by the Institute of Highway Engineers states, “The risk of a secondary accident cannot be considered equal with the primary risk. A study of the behaviour of structures during crash tests indicates that the ‘debris’ will generally fall back over the vehicle at high speed and forward at low speed, and in either case be deposited close to its original position. Therefore, where a structure is situated on the verge the probability is that debris will remain on that verge.” The guide further explains: “For a secondary accident to occur the post has to be struck and fall, or be dragged onto the carriageway, and then be of sufficient size to cause damage or an accident. This also assumes that the oncoming vehicle cannot stop or avoid the debris.

Risk assessments should recognise that primary and secondary accidents are a different order of probability: secondary accidents are very rare occurrences and therefore a very low risk.”

As discussed above,in order for the passive posts to perform as tested and expected, a number of factors need to be considered when deciding whether to use a passive post, and what performance level is ideal for that particular scenario, including but not limited to:

- → The location of the sign;
- → The permitted speed;
- → The presence of other obstacles/objects, particularly behind the potential location of the passive post;
- → The (planned) presence of any Vehicle Restraint Systems or lack thereof.

If all these factors are taken into account, and the right, tested solution is selected and installed in a compliant way, the result will be a much improved, safer environment for vehicle occupants.

About Varley & Gulliver And Our Commitment To Road Safety

Varley & Gulliver is a leading UK manufacturer of road safety solutions designed to minimise the risk of a collision or to reduce the impact in the event of a crash.

Our solutions include bridge parapets, pedestrian barriers and passive sign supports. They are compliant with the most stringent safety standards; they are tested to EN1317, they are CE marked, MASH and NCHRP350 approved as required, and many of them not only meet world safety standards but exceed them. This is supported by a range of services, including supply, installation, inspection, refurbishment and repair.

As part of Hill & Smith infrastructure, through our sister companies, each led by industry experts with many years of experience in their fields, we can provide you with complementary solutions for a wide range of projects.

We are passionate about road safety, and we are dedicated to quality and continuous process improvement. With over 60 years of knowledge, we have the experience and expertise to support engineers and road authorities on the most complex of schemes, from design to installation. Understanding client needs and the latest safety standards makes us capable of providing you with expert advice and helping you select the right solutions for a wide variety of applications.

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