Incorporating Passive Safety into Traffic Signals

Ashley Newnham FIHE

ashley.newnham@yunextraffic.com

Author

Ashley Newnham is Senior Engineer at Yunex Traffic. However, this paper was written by Ashley while previously employed by WSP and offered independently of Yunex Traffic or WSP. Any opinion or advice offered is that of Ashley Newnham only. Ashley is also a member of the B/509/10 Technical Committee for Break Away Safety. This committee is entrusted with the UK participation in the preparation of BS EN 12767.

Introduction

Traffic signal poles are vital to the safe operation of UK road networks but can pose a serious hazard if struck by vehicles. Incorporating passive safety into design packages helps reduce injury severity in collisions and supports national safety goals.

In the UK, passive safety is governed by standards such as BS EN 12767, which classifies structures based on crash performance, and must be considered alongside the Design Manual for Roads and Bridges (DMRB) and other guidance. Best practices include the use of break-away or deformable poles, appropriate placement outside clear zones and careful co-ordination with vehicle restraint systems.

This paper outlines key considerations and best practices for integrating passive safety into traffic signal design packages, providing practical guidance for UK highway authorities and designers seeking to improve roadside safety.

Although this paper focuses on traffic signal poles, many of the principles and processes discussed will be relevant and transferable for sign supports and lighting columns.

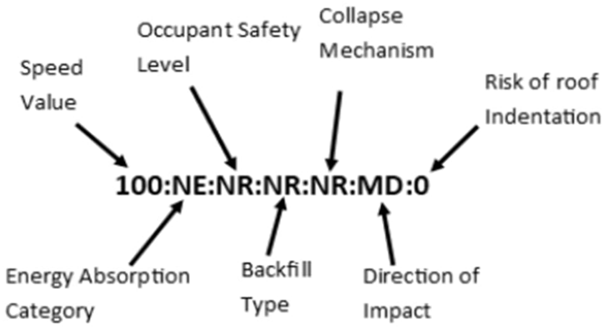
What is Passive Safety?

Traffic signs, lighting columns, and other highway structures play an important role in road safety and driver guidance. However, designers must consider that roadside installations can pose a hazard to vehicle occupants if a vehicle leaves the carriageway. To mitigate this risk, passively safe structures are designed to reduce impact severity by offering less resistance upon collision, with performance verified through testing.

All such structures must meet relevant structural standards – for traffic signs, this is BS EN 12899-1. Passive safety is an additional requirement and does not replace the need for the structure to support specified loads. The only exception allowed is a relaxation of deflection requirements.

Classifications

When pole products are crash-tested, the results are categorized in the following ways and concatenated into a single classification as shown in figure 1 taken from IHE Sign Structures Guide.



- Impact Speed - The speed at which the product was crash tested:
  - 35kph;
  - 50kph;
  - 70kph; or
  - 100kph.
- Energy Absorption category - How much the vehicle is reduced in speed on impact. I.e. How much of the vehicle's kinetic energy is transferred to the structure.
  - High Energy (HE);
  - Low Energy (LE); or
  - No Energy (NE).
- Occupant Safety Level - Categorisation based upon a combination of levels of Acceleration Severity Impact (ASI) and Theoretical Head Impact Velocity (THIV) upon vehicle occupants.
  - A (Most desirable);
  - B;
  - C;
  - D; or
  - E (E minimum required to pass crash test).
- Backfill Type - The type of backfill used in the product's crash test:
  - Standard aggregates (S);
  - Special (X); or
  - Rigid (R)
- Collapse mode - Mechanism by which the support structure deforms under vehicle impact:
  - Separation (SE); or
  - No Separation (NS).
- Direction of impact - Classification of whether the crash test results is achieved for impacts in a variety of angles:
  - Multi-Directional (MD) - most preferable;
  - Bi-Directional (BD); or
  - Single-Directional (SD) - Least preferable
- Risk of roof indentation - Measure of vehicle roof indentation caused in crash test:
  - 0: Roof deformation less than 102mm; or
  - 1: Roof deformation equal to or greater than 102mm

Regulations, Guidance and Standards

Designers are bound by legal responsibilities through regulations such as the CDM Regulation 2015 and will conduct their designs in accordance with the latest standards and guidance documents available.

Regulations

CDM Regulations 2015 place a duty upon all designers to reduce risk as far as practicable. Therefore, where there is an opportunity to reduce risk to highway users through the use of passively safe poles there is a legal requirement for designers to take that opportunity.

Standards and Guidance

DMRB TD101 Traffic signalling systems (design), clause 3.21, states “The need for any passive safety elements within the traffic signalling installation, including any electrical isolation system, shall be reviewed at the design stage”. It would therefore be departure from standard to not assess whether there is a need for passively safe structures.

Clause 2.8 of the same standard states *“The design of the traffic signalling installation shall meet the requirements of the Traffic Signs Manual Chapter 6 TSM Chapter 6 2019”*

Clause 2.1.3. of Chapter 6 refers to another piece of guidance that replaced The Code of Practice for Traffic Control and Information Systems (DMRB TA84 – Withdrawn). Chapter 6 states that *“The IHE Guidance Note ‘Traffic Control and Information Systems’ recommends and makes reference to good practice to be adopted for all traffic control systems”*.

The IHE Guidance note, in turn, then refers to two other documents:

- The design package should include *“evidence of a Passive Safety assessment (in accordance with BS EN: 12767:2019 (UK National Annex))”*. The latest version of this standard is BS EN 12767:2019+A1:2024 Passive safety of support structures for road equipment — Requirements and test methods (Incorporating corrigendum September 2023). As well as setting out the test requirements, it also contains a national annex.
- *“Guidance on the use of passively safe equipment can be found in the document ‘Passive Safety UK Guidelines for Specification and Use of Passively Safe Street Furniture on the UK Road Network (update 24/01/2020)”*. These guidelines have since been superseded by the Safer Roadsides Guidelines 2025.

The IHE Sign Structures guide and ARTSM Guidance on Passively Safe Product Requirements in the UK also provide valuable insight into the various elements that make up a passive safety classification.

Misconceptions

Some misconceptions persist around the purpose of passive safety and the classification systems are commonly misunderstood.

Speed

A very common misconception is that passive safety only needs to be considered on roads with a speed limit of 50mph or higher. This is likely due to DMRB CD377 Requirements for Road Restraint systems stating that that standard is only to be implemented on roads with speed limits of 50mph or higher. However, although this standard does discuss the use of passively safe equipment as a possible alternative to road restraint systems and the use of passively safe structures alongside road restraint systems, it does not advise on which situations the use of passively safe structures is appropriate for.

IHE Traffic Control and Information Systems states *"In 2008, BS EN: 12767 was amended to include a new National Annex. This Annex stipulates that passively safe infrastructure must be considered on all speeds of roads including those less than or equal to 40mph (Table NA.4)".*

Safer Roadside Guidelines 2025 states *"it should be noted that all passively safe products tested to EN 12767 will be much safer in any impact at any speed than traditional steel or concrete posts"*.

Class:0

Class:0 is commonly thought to be the classification given to traditional steel or concrete columns. However, Class:0 is actually a catch all term for all products that have either not been crash-tested or were crash-tested but failed to achieve a classification under the requirements of BS EN 12767.

If a pole is specified within a design as Class:0 the designer is not stating that they want a traditional steel pole. They are actually stating that they do not care how that pole performs in the event of a collision. I.e. It specifies that you are not specifying. This pseudo-classification is often mistakenly used for two reasons:

Protection – Some think that by specifying Class:0 they will get a "stronger" pole which will offer protection to any pedestrians stood behind it.

1. Firstly, as Class:0 includes all untested pole products, this could allow for an even more easily deformable pole to be installed while still meeting the design's requirements/specification.
2. Secondly, as can be seen from crash test footage a traditional mild steel pole with a nominal 4mm wall thickness would not provide adequate protection for anyone stood immediately behind it.
3. Thirdly, if protection of another hazard beyond the pole is required it should be relied upon that the errant vehicle will hit the pole. If a further hazard needs protecting a vehicle restraint system should be considered.
4. Finally, although poles should not be used as a restraint system, if the designer did want to specify a requirement for the pole to be able to stop or significantly reduce a vehicle's velocity then this could actually be achieved by specifying a pole product with a measurable performance in this regard such as a passive pole with a High-Energy (HE) energy absorption category.

Secondary Incidents – Another often-stated argument against the use of passively safe poles is that they may sheer off in event of a collision and cause a further incident.

1. Firstly, again by stating a Class:0 pole, the designer would be specifying that they are not specifying how this pole should behave in the event of a collision. A pole that is even more liable to cause a secondary incident could be selected and still meet the design requirements.
2. Secondly, the IHE Sign Structures Guide states "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".
3. Finally, if the designer wished to specify a requirement for the pole to not separate from its base this could be achieved by specifying a pole product with a measurable and demonstrated performance in this regard such as a passive pole with a Non-Separating (NS) collapse mode category.

Cost

The use of passively safe poles is often eschewed due to their typically higher cost compared to their mild steel, non-passive, alternatives. While the initial purchase price of a passive pole is usually higher, the expected lifespan of the pole is also much longer. Without damage, an aluminium passively safe pole would be expected to have a lifespan of around 2.5 times that of a traditional galvanised mild steel pole. With reduced-carbon aluminium products being brought to the market, they also offer potential carbon savings.

How to implement passive within a design process

As can be seen above, there is plenty of advice available on when to use passively safe poles and the national annex of BS EN 12767 advises which classification is most preferable there remains great variation and inconsistency in how this process is incorporated and documented with the design process and the design package it produces. The following process should be seen as an example of best practice for the incorporation of passive safety into a design process:

Step 1: Risk Management Schedule (1)

All traffic signal sites by their inherent nature will involve a risk of injury to vehicle occupants in the event of a collision with a traffic signal pole. This risk should be logged in the Designers' Risk Management Schedule from the outset of the design process.

Step 2: Record Decisions

Decisions on what guidance the design is going to be based upon and what process, such as a bespoke assessment tool, is going to be used should be logged either in a technical note that accompanies the design or in a designers' decision register.

Step 3: Preliminary Design

At this point, preliminary design can be carried out to determine at least the following:

- Pole Locations.
- Equipment to be mounted on each pole.
- Mounting Height of equipment.
  - Ground clearance to bottom of standard height signal heads.
  - Height of any high-level duplicate signal heads

Step 4: Passive Pole Risk Assessment

Now the preferred signal head mounting arrangements have been determined, an assessment of whether risk would be reduced if poles were passively safe, and if so, which passive safety classification would reduce risk as far as practicable. This assessment could be carried out in two ways:

a) Assess whether the site, as a whole, requires passive poles and apply a passively safe classification to all poles.
   - Advantage: All pole products installed at the same time should have a roughly similar lifespan.
   - Advantage: Simplifies assessment process.
   - Disadvantage: May specify passively safe poles at some locations where they will not provide any safety benefit.

b) Assess each individual pole on its own merits.
   - Advantage: Only specifies passive poles where they will provide a safety benefit.
   - Disadvantage: More time needed for assessment.
   - Disadvantage: May result in a greater variety of pole products required at a single site.

In either form of assessment, some level of pole-by-pole assessment will be needed to select the appropriate classification as advised by the BS EN 12767 national annex.

Attributes that should be considered in the assessment process include:

- Proximity of pole to carriageway
- Records of errant vehicles reaching the pole location
- Adjacent non-passive structures (E.g. walls)
- Any protection already provided by a vehicle restraint system.
- Road type: Motorway, A road, B road, country lane, etc.
- Rural or urban/built-up environment
- Speed of vehicles based upon
    - Speed limit;
    - Design speed; and
    - Observed speed E.g. 85th percentile.
- Vehicle parking
- Traffic volume
- Obvious high-risk location E.g. outside of a bend
- Any pertinent collision history
- Likely proximity of non-motorised users
- Locations that debris from a collision could fall to

Step 5: Check Feasibility / Strength Analysis

At this point, the feasibility of whether a pole product can be provided that achieves both the desired passive safety classification and passes strength analysis testing to BS EN 12899-1. To do this, it is recommended that a pole manufacturer be consulted.

If a pole manufacturer confirms that suitable poles can be provided that meet the required specification, the designer can move onto detailed design (Step 6). Drawings/data sheets of the pole products and copies of the strength calculations should be saved within the design file for future reference and for any future technical queries if/when the Contractor is sourcing poles at construction.

The design package should not specify the checked pole product or its manufacturer, or any other specific pole product or manufacturer, to ensure compliance with procurement contract rules. The design should merely present a performance specification of a passive safety classification that must be achieved. The Contractor is at liberty to supply any pole product that meets the performance classification stated within the design.

If a pole manufacturer confirms that suitable poles cannot be provided to the required specification the designer will need to return to the preliminary design stage (Step 3) and make an assessment of what measure will be the safest design option. Options may include:

- Splitting signal equipment over multiple poles.
- Moving some heads to alternative poles so the maximum load on a single pole can be reduced.
- Revert to a non-passive pole. However, this should only be done if the risk caused/increased by relocating signal heads / not having high-level heads is deemed greater than increased risk from use of a non-passive pole. I would urge this to be seen as a last resort and the above options should be explored first.

Step 6: Detailed Design

The detailed design can now be completed including specifying the most preferable passive pole classification to be used for each traffic signal pole. The most preferable pole type advised by BS EN 12767 should be specified even if it is not yet available to market. For any pole classifications not yet available, such as 100:HE:NR:NR:NR:MD:0, a list of the next most preferable classifications should be provided. The list should continue as far as necessary to get to a pole that is available at time of design. This is to ensure the safest possible infrastructure is delivered on site.

Many years could potentially pass between the completion of a design package and its construction. These delays are often not anticipated or expected when the design is being carried out. If only the best currently available pole classification was provided, a more preferable and potentially safer pole type could become available prior to construction and not be taken advantage of.

Step 7: Risk Management Schedule (2)

The measures that have been taken in the design to reduce risk need to be logged in the Designers' risk management schedule including the outcomes of passive safety. This is the evidence you have carried out your duties as a Designer under CDM.

If the most preferable pole classification specified is one that is not currently available to market at time of design consideration should be given to including a residual risk symbol within design drawings to highlight a compulsory action for the Contractor to review the pole classifications available at time of procurement to ensure the most preferable pole class is used.

Step 8: Implementation

At site acceptance testing (SAT) the commissioning engineer should check that poles adhering to the pole classifications specified have been supplied.

Registration of the supplied pole products to the latest version of TOPAS2546 provides a simple and robust method of verifying evidence of testing and technical requirements. ARTSM Guidance on Passively Safe Product Requirements in the UK states:

"Registration to TOPAS means that the technical files and the certifications have been checked for completeness in full, removing the need for procurers to undertake this. This is particularly important for products covered under BS EN 12767 since there are different testing regimes (e.g. non harmful structures) and because there is no CE/CA mark requirement. The TOPAS process undertakes independent assessment and provides a public register of those products for use by procurers and other manufacturers. It is a robust process which is well recognised in other areas of the UK road traffic management, safety and control".

Step9: Post-Construction

In as-built drawings it is recommended that, as well as the passive pole classification of the installed poles, the preferable pole class is also included so that any newly available pole classifications are taken advantage of during any ongoing repairs, maintenance or refurbishment of the site until its demolition or replacement by an alternative design (This would restart the above process).

Electrical Isolation

The use of passive poles is often linked with the use of electrical isolation systems. The above process addresses the risk of injury to vehicle occupants from impact with a structure. Risks of electrocution and/or risk of explosion from sparking cables is a separate risk, with completely different risk reduction methods, such as electrical isolation, and should therefore be considered separately.

The use of passive poles and the use of an electrical isolation system are not dependant on each other. An electrical isolation system could be provided with a non-passive pole, and a passive pole can be provided without electrical isolation system. However, care must be taken when providing an electrical isolation system for a passive pole to ensure the isolation system type used will not impair the performance of the pole achieving its passive safety performance.

For advice on electrical isolation systems refer to the IHE Passive Safety Electrical Guide 2021.

Cabinets

A passively safe cabinet is currently listed against TOPAS2546. However, although suitable for other purposes, this cabinet cannot be used as a traffic signal controller cabinet, which requires more specific environmental protection as stated in TOPAS2130.

In any case, designers should be looking to position the controller cabinet where the likelihood of a vehicle colliding with it, or operatives working at it, is minimised to reduce the risk as far as practicable.

Summary

Passive safety has a key role to play in making our roads safer. This role has been largely underestimated and/or underutilised up to now.

Through a robust assessment and design process, such as that laid out in this paper, we can maximise the effective use of advancements in passively safe street furniture, ultimately making our road networks safer and save lives.

However, misconceptions remain that require challenge, and opportunities remain for products achieving more preferable pole classifications, or greater load capacity while achieving the safe passive performance, to be developed so the most preferable pole classification can be used in all situations. Hopefully, investment in the research and development of such products will be forthcoming.

Acknowledgements

Special thanks are due to Paul Scrace and his colleagues at Hydro Extrusions for their assistance in carrying out and providing strength calculations.

References

Passive Safety UK (2025), *Safer Roadsides Guidelines 2025.* Available at: https://www.ukroads.org/passivesafety/scripts/news.asp

British Standards Limited (2024), *BS EN 12767:2019+A1:2024 Passive safety of support structures for road equipment. Requirements and test methods.* Available at: https://knowledge.bsigroup.com/products/passive-safety-of-support-structures-for-road-equipment-requirements-and-test-methods-3

National Highways (August 2022), *Design Manual for Roads and Bridges TD 101 Traffic signalling systems (design).* Available at: https://www.standardsforhighways.co.uk/search/html/a50aa56a-ffb0-4eac-8d3b-8b380cd0d636?standard=DMRB

National Highways (January 2021), *Design Manual for Roads and Bridges CD 377 Requirements for road restraint systems.* Available at: https://www.standardsforhighways.co.uk/tses/attachments/1fe48581-82ba-4b6f-95a1-ee93309bd1b5?inline=true

Department for Transport (2019), *Traffic Signs Manual Chapter 6 Traffic Control*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/851465/dft-traffic-signs-manual-chapter-6.pdf

Association for Road Traffic Safety and Management (February 2024), *Guidance on Passively Safe Product Requirements in the UK*. Available at: https://artsm.org.uk/media/GUIDANCE-ON-PASSIVELY-SAFE-PRODUCT-REQUIREMENTS-Final-v4-2.pdf

Association for Road Traffic Safety and Management (May 2025), *Guidance on Foundations for Passively Safe Products in the UK*. Available at: https://artsm.org.uk/media/Guidance-on-foundations-FINAL-120525.pdf

Institute of Highway Engineers (2020) *IHE GUIDANCE NOTE Traffic Control and Information Systems*. Available at: https://www.theihe.org/wp-content/uploads/2020/03/5-IHE-Traffic-Control-Info-Systems.pdf

Institute of Highway Engineers (January 2021) *Sign Structures Guide 2021: Support design for permanent UK traffic signs to BS EN 12899-1 and Eurocodes*. Available at: https://www.theihe.org/wp-content/uploads/2023/12/IHE-Sign-Structures-Guide-2021.pdf

Institute of Highway Engineers (September 2021) *Passive Safety Electrical Guide: Electrical requirements for passively safe ITS roadside installations to BS EN 12767*. Available at: https://www.theihe.org/wp-content/uploads/2021/09/Passive-Safety-Electrical-Guide-2021-Final-Web.pdf