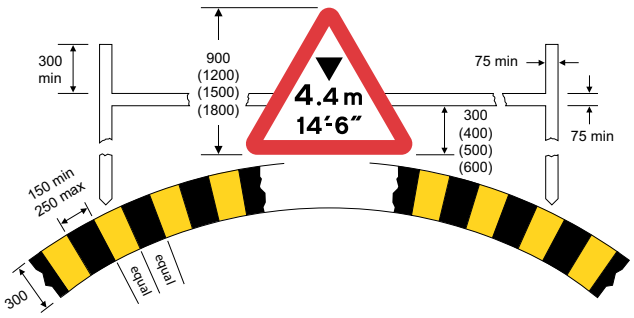
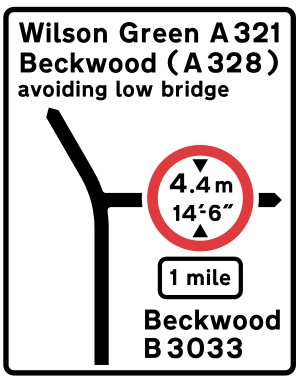
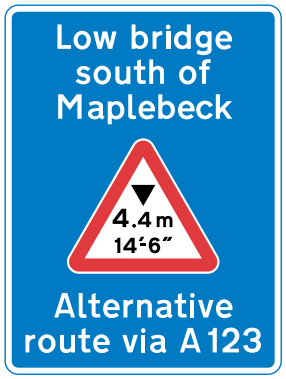
PREVENTION OF STRIKES ON BRIDGES OVER HIGHWAYS

A PROTOCOL FOR HIGHWAY MANAGERS & BRIDGE OWNERS

ISSUE 2







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This document has been prepared by a working group including representatives from ADEPT, Department for Transport, Network Rail and London Underground on behalf of the Bridge Strike Prevention Group. It is part of a continuing effort to raise the awareness of the dangers of bridge strikes amongst all those involved in highway transport and infrastructure maintenance to reduce the frequency of impacts on bridge structures over public highways. This issue supersedes the original document published in October 2007. This revision takes into account feedback on the first issue and includes reference to signing changes introduced by the Traffic Signs (Amendment) (No 2) Regulations and General Directions 2011 and the revised Traffic Signs Manual.

The information contained in this document is believed to be correct at the time of publication but regulations, standards and specifications do change. The reader should refer to their organisations' latest instructions which this document does not supersede.

The Bridge Strike Prevention Group and the contributors to this document have used their best endeavours to make sure that the content, layout and text of this document are accurate.

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July 2014

A Protocol for Highway Managers and Bridge Owners

Purpose: To give guidance and advice to Highway Managers and bridge owners to prevent strikes on bridges that span public highways.

Scope:

- the guidance is intended for all Highway Authorities (where the term Highway Authority appears in this document it shall be deemed to include reference to Road Authorities in Scotland and Northern Ireland) and for all Local Authorities, Transport Authorities and other public authorities and private companies who own bridges over public highways.
- additionally, the advice is pertinent to owners of bridges carrying railways or public highways over private access roads.
- the guidance applies to all bridges, with and without headroom signs, over vehicular highways.
- this revision includes:
  - Signing changes introduced by the Traffic Signs (Amendment) (No 2) Regulations and General Directions 2011 and the revised Traffic Signs Manual Chapter 4.
  - Recommendations for a review of traffic signs at low bridges
  - Clarification of responsibility for provision of signing at low bridges.
  - Guidance on cleaning of traffic signs on railway bridges.
  - Bridge Audit Checklist.

Contents

1 Introduction

1.01 There is no legislation limiting the height of vehicles which can travel on the roads in the UK or requiring drivers to notify or seek approval to travel in respect of any threshold in vehicle height. Because of this, there are a number of issues that need to be clearly stated, understood and addressed where roads go under bridges. This is particularly the case for the prevention of bridge strikes, the consequences of which are always costly and which can be fatal for both the driver of the vehicle and the people on or under the bridge in passing rail or road traffic.

1.02 The following protocol seeks to identify these issues and recommend practices and procedures which, if followed, will contribute towards the prevention of bridge strikes, thereby ensuring greater safety for all travellers.

1.03 Whilst there is no one panacea to the problems of bridge strikes, it is important to increase driver understanding and awareness if the number of bridge strikes is to be reduced. For this to happen, one vital ingredient is for a consistent approach to traffic signs and road maintenance at and in advance of bridges to be applied across the country.

1.04 The standard minimum clearance to be provided over every part of the carriageway of a public highway is 16'6" (5.03m). All bridges with headroom less than this value should be signed to identify the maximum height of a vehicle which can safely pass on the carriageway under the bridge without impacting on it.

For the purpose of this document the term carriageway is deemed to be the part of the highway laid out for use by vehicles, and includes hard shoulders where appropriate.

Bridges with headroom beneath the signing threshold are generally referred to in this protocol as 'low bridges'.

1.05 Bridge strikes are a particular problem for Rail Authorities who incur high costs from disruption to train services and structural repairs from the many impacts on their bridges, and for whom a derailment due to misaligned track is an ever present danger. At bridges skewed to the road alignment, there have also been instances of lorries or their loads, being overturned onto vehicles or pedestrians in adjacent lanes/footways.

1.06 For the purposes of this Protocol references to traffic signs should be deemed to be traffic signs which comply with the Traffic Signs Regulations and General Directions 2002[1] (TSRGD) (as amended) (or are approved by the Secretary of State for Transport, the Scottish Government, or the Welsh Government as appropriate under special signs authorisation) or the Traffic Signs Regulations (Northern Ireland) 1997[2] (as amended), including black and yellow hazard warning signs and road markings and the TSM4[3] and TSM5[4].

1.07 Highway Authorities are responsible for the provision of traffic signs on public highways. Bridge owners should facilitate the installation of traffic signs on their structures over public highways.

Bridge owners other than Highway Authorities are not legally empowered to install traffic signs on public highways including on their bridges unless acting as agents for the Highway Authority. Installation of traffic signs on public highways by bridge owners must be through the Highway Authority.

Bridge owners should give consent to the erection of traffic signs on their structures in a timely manner. Such consent should not unreasonably be withheld.

Responsibility for inspection and maintenance of traffic signs on public highways is vested in the Highway Authority unless subject to a legal agreement with a third party such as a bridge owner.

It should be noted however that bridge owners may include inspection of traffic signs on low bridges in their bridge examinations, and should report problems to the Highway Authority.

1.08 Highway Authorities also have major problems at unsigned bridges with many hit and run incidents where concrete is damaged or beams distorted which are not reported at the time. Such hit and run incidents are also a risk to rail bridges.

Structures such as footbridges or pipe gantries are particularly vulnerable where drivers are careless about the height of their loads and, as a result of such carelessness; several have been dislodged or brought down over the years across the country.

1.09 Bridge strikes can also be a problem for the Canal and River Trust where aqueducts cross roads and operators of light rail systems, tramways and other non-main line railways such as preserved railways that travel over former main line railway infrastructure.

1.10 The UK Bridges Board recommended in letters sent to Highway Authority Chief Executives in England and Scotland (the Welsh Government issued a similar letter at the request of the UK Bridges Board) that the provision and maintenance of traffic signs for low bridges should be reviewed and improved as necessary at, and on the approaches to the bridges on the highway network that are at risk of vehicle impact.

The letters advised that the research (see 10.02) had identified that the standard and maintenance of traffic signs at frequently struck low bridges was variable and, in many cases, was not of benefit to vehicle drivers. The letter stated that:

- at these bridges generally there are traffic signs at the bridge, and in some cases in advance of the bridge
- there appears to be little consideration given to advance signing or signing alternative routes that the vehicle driver should take to avoid the restriction
- in some cases the first traffic sign indicating a height restriction that the driver would see was when in close proximity to the bridge.

1 The Traffic Signs Regulations and General Directions 2002 (SI 2002 No. 3113) London: TSO
2 Traffic Signs Regulations (Northern Ireland) 1997 (NISR1997 No. 386) London: TSO
3 Traffic Signs Manual Chapter 4 'Warning Signs', (2013), London: TSO
4 Traffic Signs Manual Chapter 5 'Road Markings', (2003), London: TSO

From reports of bridge strikes at other bridges, this confirmed a suspicion that one of the contributory causes of bridge strikes is likely to be inappropriate, incorrect or insufficient signs at low bridges.

1.11 The UK Roads Liaison Group endorses this Protocol and urges all Highway Authorities and bridge owners to adopt the practices recommended herein. In this way, a consistent approach can be applied across the country so as to increase driver understanding and awareness.

This protocol is supported by the Association of Chief Police Officers and Police Authorities in Scotland and Northern Ireland.

1.12 Proactive liaison between interested parties will be essential to minimise the risk which bridge strikes bring to both the transport industry and public safety.

1.13 Historic bridges are a valuable part of our heritage. Highway Managers can have a crucial role to play in maintaining these bridges particularly those which have substandard headroom thereby making them susceptible to bridge strikes. National heritage organisations therefore consider that liaison with them or obtaining local heritage advice is essential prior to undertaking work to such historic bridges.

1.14 There are a number of other tools in the kit for supplementing signing where problems of bridge strikes persist. They, together with comments, are described in Appendix B.

1.15 For the purposes of this Protocol references to legislation should be deemed to be the equivalent legislation in force in Northern Ireland.

In Northern Ireland the relevant legislation is the Traffic Signs Regulations (Northern Ireland) 1997[2] (as amended). Diagram and regulation numbering occasionally differs in these Regulations and there are no General Directions.

Sign layouts, meanings and permitted variants are generally similar but can vary. Not all signs referred to in the text are included in the Northern Ireland Regulations. References to General Directions are not applicable in Northern Ireland; where these are referred to, advice should be sought from the Department of Regional Development (DRD), Roads Service, Northern Ireland.

2 *Signing of restricted headroom at bridges*

General

2.01 There is no primary legislation that sets out a duty to sign low bridges or to seek approval to move high loads. Coupled with a common misunderstanding among drivers of the height of a vehicle which can safely be driven under an unsigned bridge, this creates particular difficulties. It is accepted however that, as part of their duty under Section 122 of the Road Traffic Regulation Act 1984[5] to secure the expeditious, convenient and safe movement of vehicular and other traffic (including pedestrians), Highway Authorities should sign all bridges over highways with less than 16'6" (5.03m) headroom at any point over the carriageway, and also maintain such signing.

Figure 1: Dual Metric/Imperial Warning Sign

2.02 It is a requirement of TSRGD[1] (as amended) that heights must be shown in imperial dimensions and may additionally be shown in metric units. They must not be displayed in metric units alone. It is considered best practice however, given the volume of foreign freight traffic in the country, for all signing upgrade schemes to include for dual unit dimension signing (note that the 2011 amendment[6] to TSRGD has prescribed a dual metric/imperial dimension warning sign – see Figure 1).

Consideration should also be given to implementing a change to include dual unit dimension signing at all low bridges.

2.03 Paragraph 7.6 of TSM4[3] advises that it is important that signs and markings on low bridges, including hazard markings are correctly installed and maintained. For non-arch bridges, the guidance in TSM4[3] paragraphs 7.17 – 7.20 should be followed, and paragraphs 7.21 – 7.24 for arch bridges. In addition to the use of signs at, or immediately before, low bridges, and the use of black and yellow hazard markings to make the bridge soffit more conspicuous, the guidance covers other signing to give advance warning.

2.04 There are two types of signs, warning (triangular), which can be used at any bridge, and mandatory (roundels), where use is limited to flat soffit bridges. Until 1994 the use of mandatory height limit signs rather than warning triangles for non-arch bridges had to be backed by a specific traffic regulation order.

5 Road Traffic Regulation Act 1984

6 The Traffic Signs (Amendment) (No.2) Regulations and General Directions 2011 (SI 2011 No. 3041) London: TSO

When the Traffic Signs Regulations and General Directions 1994 (now revoked by SI 2002 No. 3113[1]) came into force, this was no longer necessary as it became an offence in England, Scotland and Wales (under the Road Traffic Act 1988[7]) to fail to comply with a height limit roundel placed to indicate a physical height restriction, without the need for a supporting order. This facilitates easier installation of the signs and related prosecution of drivers who ignore them.

Detailed guidance on the positioning of mandatory signs is given in TSM4[3] paragraph 7.17 and 7.18 and advice on the location of warning signs in paragraph 7.21 to 7.24.

This is not the case in Northern Ireland where a Traffic Regulation Order (TRO) is still required.

2.05 It is essential that adequate advance warning of a height restriction is given to drivers. This is to avoid abortive travel to the bridge in the first place, and the possibility that having arrived at a low bridge, drivers may be tempted to drive under the bridge. Therefore, advance signing at the last feasible turning point/junction before the bridge should be provided to enable drivers to reroute without having to turn around.

Where practical, signs should be positioned away from junctions, roundabouts or other complex situations and large light sources or distractions to improve their likelihood of being seen.

2.06 Signs further away from the last junction may also be beneficial to give drivers the earliest opportunity to choose a different route. Joint working between neighbouring authorities will be required where such signs are required to be located beyond a Highway Authority's boundary.

2.07 From the above, the recommended system for signing a bridge at risk of bridge strikes is therefore as follows:

a) Signs attached to each elevation of the bridge accompanied by appropriate reflectorised hazard markings covering the width of carriageway to which the limit applies.

b) Post mounted signs on the road an appropriate distance in advance of the bridge on each approach to the bridge (it is essential that these signs are provided in advance of skew bridges to prevent vehicles striking a low skew bridge before passing any sign). It should be noted however that mandatory signs must be located to avoid restricting vehicular access to any adjacent entrance.

c) Advance signs advising of the restriction and the distance to it at the last junction on each approach to the bridge and on each leg of that junction.

d) Advance signs at the nearest major junction and on the related direction flag signs. Advance signing should make sense to drivers unfamiliar with the area. White on black signs (diagrams 2805, 2806 or 2806.1) to indicate routes for goods vehicles to high use sites are also a useful aid.

e) Road markings to guide high vehicles under the centre of an arch bridge possibly with associated yellow box marking (See Appendix B 7.3).

The type of sign (roundel or triangular) and unit of dimensions shown on advance signs should be the same as that on the bridge and vice versa.

The traffic signs to be provided at a particular location should be assessed on a bridge by bridge basis.

2.08 Any signing system proposals (whether they originate from the Rail or Highway Authority) which could significantly affect the driver's perception of the road should be submitted for safety audit in accordance with HD19[8].

Any proposals for the installation of signs on bridges owned by other than the Highway Authority e.g. railway bridges should be submitted to the bridge owner for approval.

2.09 The shape, size, background colour, size of lettering, etc, on a sign, is specified in the TSRGD[1] (as amended). Further guidance can be found in TSM4[3] and TSM7[9]. This includes advice on the sizes of sign appropriate for different traffic speeds. Where alternatives are allowed, the sensitivity of the site to bridge strikes, the frequency of strikes, the environment and any local signing policy and relevant priority should be considered in determining the eventual choice.

If there are situations where signs larger than the maximum prescribed size (1500mm) might be considered appropriate to afford better visibility approval must be sought from the Department for Transport (for signs in England), Transport Scotland, Welsh Government or Department of Regional Development (DRD), Roads Service, Northern Ireland as applicable.

2.10 The positioning of signs needs particular care. Detailed advice is given in TSM4[3] paragraphs 1.20 – 1.23, and Appendix A which specify minimum clear visibility distances. Signs must be located in a place and at a height where they are visible to all relevant traffic on every approach. This will determine the number of signs needed at any junction. Anticipating the growth of vegetation which might restrict visibility is particularly important.

TSM4[3] paragraph 7.18 gives guidance as to when signs should be erected on posts immediately adjacent to the bridge. These signs are essential for skew bridges.

2.11 If following work to the bridge or highway, for example due to the installation of a collision protection beam, road resurfacing or re-profiling or a following a planned review of traffic signs at a bridge (see 8.05 – 8.08), a change in the headroom is identified, the signs on the bridge and on the approach must be changed as necessary.

Guidance on determining the signed height following erection of collision protection beams is given in BD65[10].

Signs to diagram 7014.1 (Figure 2) may be installed for a maximum 6 months to draw drivers' attention to a change in the signed height.

7 Road Traffic Act 1988

8 Design Manual for Roads and Bridges (DMRB) Volume 5: Assessment and Preparation of Road Schemes: Section 2, Part 2: HD19/03 Road Safety Audit November 2003: London: TSO

9 Traffic Signs Manual Chapter 7 'The Design of Traffic Signs' (2013) London: TSO

10 Design Manual for Roads and Bridges (DMRB) Volume 2: Highway Structures: Design (Substructures and Special Structures), Materials: Section 2, Part 5: BD 65/97 Design Criteria for Collision Protection Beams: February 1997: London: TSO (Note this standard is planned to be revised in 2014)

Figure 2: Sign to Diagram 7014.1

2.12 Some retroreflective sign materials do not perform well when they are coated with dew. Accordingly in locations such as rural areas, where low bridge signs may be obscured by dew, dew resistant film should be used to improve the performance of the retroreflective materials.

2.13 Local authority heritage advisors (both historic buildings conservation officers and archaeological officers) should be consulted on all proposals for attaching new signs to historic bridge structures including those that are listed. They will be able to provide advice on the appropriateness of the proposals and whether consent is needed. Where a bridge is a scheduled monument national heritage organisations must be consulted in advance to determine whether Scheduled Monument Consent is required.

The significance of the bridge and or relevant designation(s) related to a bridge should be clearly identified and recorded on asset records and audit check lists.

Reducing the physical impact of traffic signs on a historic bridge is vital. It is important to maintain the overall physical and visual coherence of 'heritage assets' so they can be appreciated. Therefore every effort should be made to keep traffic signs and visual markings both on the structure and on the approach road to a structure to the minimum required to deliver safety and to protect the structure.

Consideration should be given to reducing the impact of the signs on the fabric of the structure, for example by using fittings that are removable without damage (clipping rather than drilling and screwing) or that take the nature of the structure into consideration, for example if drilling at a masonry arch bridge cannot be avoided, the fittings should be positioned so as to use mortar joints. Drilling or screwing into metallic or concrete structures should be avoided.

The relevant consents must be obtained before undertaking any works at bridges which are heritage structures.

2.14 See Appendix B for details of other options for supplementary signing.

2.15 TSM4[3] paragraphs 1.32 to 1.34 sets out guidance on the use of yellow backing boards. The DfT does not recommend the routine use of backing boards as overuse may diminish their effect when they are really needed.

Flat soffit (non-arch) bridges

2.16 Mandatory height restriction signs should be installed at bridges with flat soffits. Signs that show dual imperial/metric dimensions (diagram 629.2A) are recommended. Any planned signing scheme in the vicinity of a low bridge or general upgrade should embrace this approach. Sign changes at bridges that are often subjected to bridge strikes should be programmed early. Dual imperial/metric mandatory signs should also be provided where existing signs require replacement, for example following a bridge strike.

Consideration should be given to providing dual imperial/metric signs when the signing at a particular bridge is reviewed:

- as collision protection beams are to be installed
- as part of a strategic or planned review, including replacement of signs not in accordance with current Regulations
- where the existing signs require to be replaced because of their condition e.g. following a bridge strike.

2.17 The signs should be supplemented with appropriate black and yellow reflectorised hazard markings. Guidance is given in TSM4[3] paragraphs 7.6, 7.20, 7.24, 7.26 and 7.27.

Arch bridges

2.18 The signing of bridges with restricted headroom must cover the whole carriageway. On arch bridges, chord markings indicating the extent of the signed height should be provided. Chord markings should always be reflectorised to improve their visibility in darkness (See TSM4[3] paragraph 7.23). Where a single chord does not cover the whole carriageway the side chord(s) should also be signed. The minimum clearance of the centre chord, which shows the available headroom over a width not less than 3 metres, is however the governing height for any advance signing.

The corresponding width of carriageway which it covers must be clearly delineated with white lines and related support signing. Detailed guidance is provided in TSM4[3] paragraphs 7.23 - 7.24. Paragraph 7.24 also deals with the use of black and yellow hazard markings to emphasise the part of the structure at risk. These should also be reflectorised.

2.19 For arch bridges with headroom of at least 16'6" (5.03m) over the centre part of the arch the following options can be used:

1. Central portion signed

- sign to diagram 532.3A with central sign varied to 16'6" (5.0m)
- the central chord width is determined by the arch bridge characteristics but should not be less than 10'0" (3.0m)
- side shoulders signed between chords to indicate the headroom at the near side channel

2. Central portion unsigned (better suited to wider spans that allow two-way traffic to pass below)

- central section unsigned where there is sufficient carriageway width over which the arch is higher than 16'6" (5.03m)

- the width of the unsigned part is determined by the arch bridge characteristics but should not be less than 10'0" (3.0m)
- side shoulders signed with warning sign to diagram 530A between side chord to indicate the headroom at the near side channel, marked up to where the centre part affords headroom of at least 16'6" (5.03m)

In both cases:

- black and yellow hazard markings should be provided to the arch at the side chords
- advance signing is not necessary but road markings and related warning signs should be used at the bridge to guide higher vehicles to where the clearance is greater.

2.20 For a bridge with a carriageway less than 3m wide the chord will cover the width of the carriageway.

Composite (adjacent arch and flat soffit) bridges and bridges with multiple ownership

2.21 It is not unknown for a highway to be crossed by several bridges on a section between junctions such as when the section of road is spanned by:

- Two or more structures that are integrated as a single bridge
- Two or more separate structures in close proximity (see Figure 3)
- Structures with a combination of forms (e.g. a mixture of arch and flat soffit)
- Structures in multiple ownerships (e.g. more than one Rail Authority or adjacent road and rail bridges).

Figure 3: An example of separate structures in close proximity

At such locations the Highway Manager should:

- Ascertain the ownership of adjacent structures (which may or may not be possible from bridge identification plates) spanning the section of road.
- Identify the lowest headroom under all the bridges over the section of road when developing signing schemes.
- Hold discussions with the bridge owner(s) regarding measures to protect bridge spans at risk of bridge strikes over the section of road.

Further guidance on the signing of composite bridges is given in TSM4[3] paragraphs 7.25 to 7.27

Road markings at arch bridges

2.22 Guidance on the use of road markings to guide vehicles through arches can be found in TSM5[4] paragraphs 22.5 - 22.10.

2.23 It should be noted that where the road alignment would normally dictate the use of single or double white lines, these must not be used if it would be necessary for a vehicle to cross them in order to pass under the bridge.

Alternative methods to maintain road safety should be considered at such potentially dangerous locations, for example, traffic signals or reducing the road to a single lane with priority signing.

Diversion routes

2.24 Diversion routes avoiding low bridges need not be routinely signed. It is not a requirement to do so, but if a structure is frequently struck, consideration should be given to the provision of signing to divert over-height vehicles to an alternative route avoiding a low bridge. Further guidance is provided in TSM4[3] paragraphs 7.13 – 7.16.

2.25 There will, however, always be a presumption against an unnecessary proliferation of signs. This is both for environmental reasons in rural areas and to avoid too much conflicting and potentially distracting information in urban areas. This can be especially marked where there are two or more low bridges in close proximity to one another. Blanket installations of diversion routes would also increase significantly the installation and maintenance costs of the signs.

2.26 The responsibility for assessing the adequacy of a diversion route rests with the Highway Authority. In determining this, it is important that vehicles are not diverted under a lower bridge or through another inappropriate restriction. Similarly, diversion routes for road works closures should not send traffic under bridges lower than those on the route closed.

2.27 Where a signed diversion exists or is to be implemented, advanced warning should be given as early as practicable to minimise abortive travel. The same advice applies for locating advance signs which advise of the restriction but where the diversion route is not signed. Symbols may be used to simplify the signing around the diversion route.

Lighting

2.28 TSRGD[1] (as amended) specifies situations when signs, including those on the bridge elevations, must be illuminated. This includes signs:

- within 50 metres of a system of street lighting
- on a principal road without street lighting unless the sign is reflectorised.

In Northern Ireland traffic signs are illuminated in accordance with the Traffic Signs Regulations (Northern Ireland) 1997[2].

Measurement of headroom

2.29 All bridges with headroom of less than 16'6" (5.03m) at any point over a carriageway should be signed in accordance with the guidance given in the TSM4[3] section 7. This will, in all situations, allow a minimum safety margin for vehicle (suspension) bounce etc. of 3" or 0.1m (these are not equivalent values but each is applied in accordance with the measurement guidelines).

It is important to note that signing only relates to the headroom over the carriageway. Footways and verges are not included and so related chevrons or hazard markings must not extend beyond the limits of the carriageway.

2.30 Details of the actual measured minimum headroom available and the wider headroom envelope at a bridge with headroom not less than 16'6" (5.03m) at any point over a carriageway should also be maintained by the Highway Authority for use in responding to requests for routes for vehicles with vehicle/load combination greater than 16'3" (4.95m) around the network.

2.31 It is generally accepted that Highway Authorities will install and maintain signing at low bridges at least to minimum requirements and for this they need to measure and record the actual headroom under bridges spanning their carriageways. This should be determined by a survey of the headroom as described in clause 2.35. The headroom should be measured, and the signed height determined as specified in TSM4[3] paragraphs 7.8 -7.11 for both metric as well as imperial units of measurement. Allowance for the bridging effects of long wheel base vehicles as described in 2.35 must be made.

2.32 The exercise in 2.31 should be carried out for all sites so that the headroom can be determined where any bridge or gantry spans the road. This is to enable Highway Authorities to:

a) correctly sign bridges with less than 16'6" (5.03m) minimum headroom anywhere over the carriageway and

b) advise hauliers requesting details of headroom of bridges to plan the movements of high loads (i.e. those higher than 16'3" (4.95m)).

2.33 Remeasures should be taken by the Highway Authority:

a) before and after any surfacing work (see Appendix A)

b) when a Highway Authority receives reports or evidence of a possible change in surfacing or other circumstance having occurred which has not been recorded/measured, or otherwise that the dimension shown may be incorrect

c) when there is evidence of damage from an impact on the bridge. In this regard it is important the Highway Authority is formally notified by bridge owners of any strikes on their bridges

d) following any replacement, reconstruction or significant work by the Rail Authority or other bridge owner to the bridge superstructure or the provision of collision protection beams. The bridge owner may act as a Highway Authority's agent to determine the measured headroom.

A Highway Authority should clearly define and make known who within its organisation is responsible for receiving information and taking the necessary action.

2.34 Any reduction in the clearance that infringes the minimum 3" safety margin must be corrected as a matter of urgency by planing and resurfacing or changing the signs. If the safety margin increases to 6" (150 mm) or more, similar sign changes should be planned at the earliest practical date. Although this latter scenario is not unsafe, it will maintain consistency in the national signing regime.

2.35 Measurements of headroom should be taken vertically at least on both channels and centre-line immediately under each bridge or collision protection beam elevation and at abrupt changes in level of the bridge soffit longitudinally along the road. Additional measurements may also be necessary at any local high points in the road surface or conversely local low points or projections in the bridge soffit.

Additionally, care should be taken to allow for the bridging effect of long vehicles when determining the dimension of the signed height. This is particularly important where the road dips or hogs sharply or is on a curving alignment under the bridge; these variations in alignment are common.

Advice on how to determine the dimension shown on the traffic signs by subtracting the local sag curve correction for these situations is given in BD65[10]. It should be noted that to determine the effect of vertical curves in road alignments BD65[10] recommends use of a 2 metre grid based on a 25 metre vehicle as given in Chapter 6 of TD27[11]. Should a grid with a greater longitudinal spacing be used, there is a risk that the calculated allowance will be greater than that determined using a 2 metre grid, and thus a lower signed height shown than may actually be necessary.

2.36 It is important to check the implications of the height of abnormal loads and especially for the increased bridging effect of longer abnormal loads when processing movement notifications.

11 Design Manual for Roads and Bridges (DMRB) Volume 6: Road Geometry: Section 1, Part 2: TD 27/05 Cross Sections and Headrooms: February 2005 London: TSO

3 Register and maintenance of signs

3.01 Highway Authorities should maintain a register of all bridges over public roads within their boundaries. The register should list:

- unique bridge identification used by the Highway Authority
- name of road in which each sign is located
- name of road(s) under bridge
- form of construction
- location based on Ordnance survey co-ordinates
- bridge owner and contact details
- bridge owner's unique bridge identification
- bridge owner's bridge name
- the measured minimum headroom and location of associated survey data
- the signed height(s) on the carriageway(s) under the bridge (if applicable).

In addition, it is recommended that Highway Authorities should maintain a register of traffic signs at, adjacent and in advance of low bridges including:

- location based on Ordnance survey co-ordinates
- name of road in which each sign is located
- type of sign by reference to TSRGD[1] (as amended) diagram number
- sign dimensions
- information shown on sign including permitted height shown (metric and imperial)

3.02 Drivers of freight vehicles may use satellite navigation systems for routing. So that these systems hold up to date information there is a continuing need for effective cooperation between Highway Authorities and the satellite navigation and mapping industries to share data including the location of low bridges and the associated signed height. Highway Authorities should be prepared and able to provide maintained details of the signed height restrictions at low bridges within their jurisdiction and also provide advice of any temporary restrictions.

3.03 It is important that Highway Authorities identify clear accountability for providing, inspecting and maintaining all signs for all low headroom bridges within their jurisdiction. It is equally important that those involved with this work understand the importance of the need for correct signing, the potential dangers which arise as a result of bridge strikes and the implications for a Highway Authority if the strike can in any way be attributed to negligence or poor practice on their behalf.

Hazard markings are an integral part of the signing system and should thus be included in such maintenance considerations.

3.04 Traffic signs should be visible at all times and in all conditions. This is especially so where the implications of the signs not being visible could be catastrophic. Signs to advise of vehicle height restrictions to protect low bridges fall into this category. Guidance on sign cleaning and maintenance is given in Appendix D of this document and TSM4[3] paragraphs 1.38 – 1.40 and in TD 25[12] (see paragraphs 5.1.1 - 5.1.3).

Where low bridge signs are liable to being obscured by dew, the maintenance advice given in IAN 56[13] should be followed.

3.05 Safety inspections in accordance with Well-maintained Highways[14] should include an inspection to determine the condition of traffic signs at, adjacent to and in advance of low bridges and where applicable associated road markings. The frequencies for inspections should be decided following an assessment of the risks to all road and low bridge users including:

- road category as defined in Well-maintained Highways[14]
- traffic use and vehicle characteristics
- bridge strike history
- previous inspections

It is thus important that the Highway Authority is notified by bridge owners of any strikes on their bridges.

It is recommended that the interval between inspections should not exceed one year.

The inspection of traffic signs for low bridges should be sufficient to provide accurate, timely and relevant information to enable requirements for repairs to be identified and given appropriate priority. The inspection should be sufficient to identify:

- damaged and exposed electrical wiring to traffic signs
- damaged, defective or missing traffic signs
- missing, misleading or badly worn road markings
- obscured or dirty traffic signs
- signs not in accordance with the TSRGD[1] (as amended).

Guidance as to condition defects to traffic signs that should be reported is given in Appendix C.

The bridge audit check sheet (see Appendix E) will be a useful aid for the last bullet point and also as an aide-memoire for inspectors when completing the report form.

Rail Authorities may include an inspection of traffic signs at the bridge in their bridge examinations and if so they should report any defects to the Highway Authority.

12 Design Manual for Roads and Bridges (DMRB) Volume 8 'Traffic Signs and Lighting', Section 2, Part 2: TD 25/01 'Inspection and Maintenance of Traffic Signs on Motorway and All Purpose Trunk Roads': February 2001: London: TSO
13 Interim Advice Note IAN 56/04 'Maintenance of Traffic Signs with Dew Resistant Coatings': 2004
14 Well-maintained Highways - Code of Practice for Highway Maintenance Management: July 2005 updated April 2012: London: TSO

3.06 Inspectors need to be aware of the impact of changing conditions both seasonal and during the hours of darkness. Issues of cleanliness and loss of reflectivity of signs including black and yellow hazard markings, worn out white lines and damaged or non-operational lighting need to be reported. Also, the inspector needs to be aware of all signs listed in the Highway Authority's inventory relating to each restriction so that they can be inspected and any missing signs identified. They should also consider the need for additional signs at sites where visibility from different approaches is difficult. Particular attention should be given to the location of signs and keeping surrounding vegetation in check so that the signs can be seen at all times of the year.

3.07 The use of pro-forma for reporting these specific defects is recommended. Responsibilities for undertaking remedial works consequential of an inspection or reported bridge strike should be clearly defined.

Defect Category	Example Defect	Action and Response Time
Category 1	Live electrical wiring exposed as a result of a bridge strike	Immediately make safe and repair or replace at the earliest practical opportunity
	Signs on the bridge damaged in a bridge strike	
Category 2	Missing mandatory and/or warning signs at low bridges or on approaches to low bridges	Provide or replace at the earliest practical opportunity
	Dirty or obscured mandatory and/or warning signs and/or road markings at low bridges or on approaches to low bridges including alternative route signs	Repairs or replacement to be undertaken within a planned programme of works, with the priority as determined by risk assessment

Table 1: Example defects and the recommended actions and response times

3.08 A maintenance regime to cover routine and, if necessary, reactive maintenance must be in place to keep traffic signing systems for low bridges in serviceable condition and to enable any faults to be rectified promptly so that the traffic signs are always clearly visible to drivers.

Defects to traffic signs installed at or in advance of low bridges and the associated response times should be set out in a risk register. Guidance is provided in Well-maintained Highways[14]. Example defects and the recommended actions and response times for reported defects to traffic signs for low bridges are shown in Table 1.

The maintenance regime should specify the action to be taken to reinstate illumination of traffic signs whether warning or regulatory, and the programme for such work following receipt of a report of non-illumination.

3.09 It is accepted that Highway Authorities will have differing priorities/strategies in their Transport Asset Management Plan for inspecting and maintaining signs. Within the relevant strategy, signs for restricted headroom at low bridges should be included with those of the highest category of priority.

3.10 There may be access difficulties for maintaining signs placed on low railway bridges resulting from train related hazards and/or the need for road closures. Neither of these should prevent a sign from being attached to a bridge if that is what is needed. In these circumstances, the Highway Authority and Rail Authority should agree who is best placed to carry out maintenance and the protocol for so doing.

The responsibility for the maintenance of traffic signs, including variable message signs (VMS) (See Appendix B) for which the Rail Authority may pay a commuted sum for maintenance, remains with the Highway Authority.

4 Distractions from advertising

4.01 Advertisements distract drivers' attention. It is therefore recommended that they should not be permitted on or adjacent to bridges spanning the highway. This includes bridges owned by Rail Authorities and others.

4.02 It is further recommended that where such advertising has been licensed in the past it should not be renewed.

4.03 The erection of local event banners on or in the vicinity of bridges over the highway should similarly be banned, notwithstanding historical precedents. Additionally accidents may happen while these are being put in place and removed or from vandals loosening them while in place.

4.04 Much more careful consideration should also be given by Planning Authorities when processing applications for advertising on private land alongside the highway, especially in the vicinity of restricted height or lightweight bridges. Such approval should not be granted where drivers may be distracted or fail to observe traffic signs and thus increase the likelihood of a bridge strike.

5 Lighting in areas around the railway

5.01 Highway lighting must not interfere with a train driver's vision of signals.

5.02 For any highway lighting scheme for the roads on the approach to or under a low bridge, consultation in accordance with BS 5489[15] should include the Rail Authority.

5.03 Consideration should be given to the need for lighting under a wide (i.e. along the carriageway) bridge to highlight the soffit particularly if it changes along the road under the bridge.

15 BS 5489-1:2003+A2:2008: Code of practice for the design of road lighting. Lighting of roads and public amenity areas

6 Temporary works and working practices

6.01 When erecting temporary access or working platforms at any bridge spanning over a highway, care must be taken not to allow any projections beneath the soffit of the bridge except where the:

a) road or lane is closed to traffic

b) minimum clearance above the carriageway under the temporary works can be maintained at more than 16'6" (5.03m)

c) minimum clearance above the carriageway under the temporary works is signed as a low bridge in accordance with Section 2.

A traffic sign to diagram 7014.1 (see Figure 2) should be erected to inform drivers of any change in headroom. In addition a risk assessment should be carried out to determine whether any further measures are necessary to mitigate the risk of a bridge strike at low bridges and other bridges.

6.02 No temporary works, traffic management or working methods on the road below should force traffic under a section of bridge with less headroom than the area being obstructed, whether it is a signed bridge or not, without careful assessment of any potential adverse effects. In addition, vehicles should not be forced to mount kerbed footways which could further increase the likelihood of impact.

6.03 Clauses 6.01 and 6.02 apply to any works and Highway Authorities must be particularly vigilant in respect of works by utilities and other outside parties. Bridge owners must not block the view of traffic signs on bridges unless unavoidable, in which case, replacement signs approved by the Highway Authority should be provided during their own works.

6.04 A point of particular importance relates to works which reverse the direction of flow along a road or divert traffic onto contra-flow working on another carriageway. It is imperative that appropriate signing including height restriction signing is in place to reflect the directional change and that the bridge owner is advised before implementation as this may affect the response to a bridge strike.

6.05 Highway Authorities should make sure that those involved in the process of approving works on the highway are aware of these issues.

7 Joint working with Rail Authorities and other bridge owners

7.01 Protecting the travelling public at rail over road bridges is a joint responsibility between the Highway Authority and the Rail Authority. In this, both parties should work together to reduce the risk of bridge strikes. It is recommended that both Rail and Highway Authorities should appoint 'bridge strike champions' to raise the profile of bridge strikes within their own organisations and to act as a single point of contact so that effective liaison can take place between the organisations.

7.02 It is recommended that regular meetings are held between the Highway Authority and the appropriate body to discuss relevant issues and, when appropriate, other interested stakeholders such as emergency services, Planning Authorities, transport organisations and local haulage and bus companies should be invited to attend.

7.03 Where a height survey (see also 2.32 – 2.35 and 8.05 - 8.08) shows a change in signed height to be necessary, the Highway Authority should inform the bridge owner of the proposal before implementation.

Rail Authorities and other bridge owners should work closely with Highway Authorities to facilitate the prompt erection of traffic signs on their low bridges. Their consent to the erection of traffic signs on their structures should not unreasonably be withheld but given in a timely manner.

The bridge owner should be informed when any significant change to the traffic management, such as imposing, removing or reversing one way traffic flows under a bridge is planned as this could affect the response to a bridge strike report by the bridge owner.

7.04 Further to 1.07, should a bridge owner believe that existing traffic signs on public highways in accordance with the recommendations in this Protocol are ineffective in preventing bridge strikes, it is reasonable for the bridge owner to promote the provision of enhancements to the traffic signs through the Highway Authority.

In all situations, including where signing enhancements are funded by the bridge owner, implementation of the scheme must be through the Highway Authority and responsibility for ongoing inspection and maintenance is vested in the Highway Authority even if there is an agreement about work or cost sharing.

7.05 It is important for Highway Authorities to engage with Rail Authorities and other bridge owners when considering measures to supplement signing where problems of bridge strikes persist, as they will have a wider appreciation of what solutions have been tried nationwide and their relative success.

7.07 To accord with the New Roads and Streetworks Act 1991[16], the Highway Authority and bridge owner should cooperate to produce a coordinated programme of maintenance activities to minimise disruption to traffic under the bridge. This should be achieved through a programme of regular meetings including utilities and other external parties.

16 New Roads and Streetworks Act 1991

8 Other important considerations

8.01 Highway Authorities should ideally include the issue of bridge strikes, the potential consequences and need for protective measures in their Transport Asset Management Plans.

8.02 Planning Authorities should consider the implications for low bridges in any development proposals both during construction and eventual operation. Options that should be considered as a precondition to approval where it is determined that the development proposal will increase the risk of bridge strikes include:

- increasing the minimum headroom to 16'6" (5.03m) or more;
- enhancing existing advance and diversionary traffic signs on the approaches to the bridge;
- imposing traffic movement restrictions.

8.03 A Highway Authority should also define where responsibility lies for receiving and reacting to information about sites sensitive to bridge strikes and who should attend liaison meetings referred to in 7.02.

8.04 When developing inputs to Transport Asset Management Plans or reviewing any site which has particular problems, account should be taken of the recommendation in letters sent to Highway Authority Chief Executives (See 1.10) that the provision and maintenance of traffic signs for low bridges should be reviewed and improved as necessary at, and on the approaches to the bridges on the highway network that are at risk of vehicle impact.

8.05 Each Highway Authority should thus develop an action plan for the review and amendment of traffic signs at low bridges. The ADEPT representative on the Bridge Strike Prevention Group (BSPG) is required to report progress with the development of, and implementation against, the action plan to the Group at each 6 monthly meeting. A pro-forma report form for use by Highway Authority bridge strike champions (see 7.01) for reporting progress to BSPG is included as Appendix F.

8.06 All sites should be inspected and a record of their comparative risk made using a consistent scoring sheet for each bridge.

There are three factors that combine to give the level of risk at a particular bridge – the frequency of reported bridge strikes (average number of occasions a year), the probability of the existing traffic signs failing to prevent the bridge being struck, and the consequences in terms of death and injury. The combination of high probability of a vehicle striking a bridge, and a high likelihood of injury leads to the highest level of risk ranking.

Highway Authorities should use the same general scoring process for all roads. Authorities should give top priority to inspecting bridges known to have been struck recently or which have high rail or road traffic flows. Highway Authorities may obtain rail score information for all bridges from the relevant Rail Authority.

The Rail Authority or other bridge owner should have the opportunity to comment on the scores. Joint inspection may be appropriate.

8.07 The action plan should be implemented not later than 12 months from the date of publication of this Protocol. The action plan should rank the order of bridges at which changes to traffic signs at and in advance of low bridges are necessary based on the comparative risk.

8.08 A risk ranking shown in Appendix F has been developed to enable bridges to be ranked according to the risk arising from a bridge strike. This will allow a Highway Manager to investigate changes to traffic signs to improve bridge strike prevention.

The overall score for a bridge is obtained by adding all 14 factors. The scoring regime assumes that no factor has a score of zero.

Low bridges within each Highway Authority area should be ranked accordingly to determine their relative priority for the implementation of traffic signing improvements.

9 Action to take when informed of a bridge strike

9.01 At a Highway Authority bridge

9.01.1 In the event of a strike on a road over road bridge or footbridge, the Highway Authority must be contacted immediately so that arrangements may be made for the site to be inspected and where necessary, a structural inspection carried out. In the event that there is any doubt as to the condition of the bridge, traffic on and under it must be stopped pending the outcome of the structural inspection and the completion of any remedial works considered necessary for public safety. In the case of a low bridge further actions in 9.02.5 (b) must also be carried out.

9.01.2 The ADEPT representative on the Bridge Strike Prevention Group is required to report statistics of bridge strikes at Highway Authority bridges to the Group. Accordingly records of reported bridge strikes should be maintained, and details of all strikes for each 6 month period to the end of March and September reported by each Highway Authority.

9.02 At a Network Rail bridge

9.02.1 Network Rail is carrying out a programme to erect identification plates at all bridges spanning or carrying their railway. An example is shown in Figure 4.

The telephone number on the identification plate will vary according to location of the bridge.

Figure 4: Network Rail bridge identification plate

9.02.2 Network Rail has procedures in place so that the relevant Highway Authority will be immediately informed of a strike on a bridge within the Authority's boundary.

9.02.3 Should a Highway Manager receive advice of a bridge strike at a Network Rail bridge from someone other than Network Rail, the informant should be asked if Network Rail has been advised. If Network Rail has not been notified they should be contacted immediately using the telephone number on the bridge identification plate, if available, or the 24 hour number held by the Highway Authority. In all cases the information on the identification plate should be ascertained and the location, date and time of the incident recorded.

9.02.4 If the incident is current, after Network Rail has been informed the Police should be contacted using the 999 system.

9.02.5 Following receipt of a report of the bridge strike:

a) Network Rail will examine the structure of the bridge.

b) The Highway Authority should inspect the site and make urgent arrangements to repair any damage to traffic signs, surfacing, road markings and lighting, liaising, as necessary, with Network Rail for access to repair damaged signs attached to the bridge. This should include checking the minimum headroom (see section 2) so as to confirm or amend the dimension shown on the traffic signs.

c) In the event that there is any doubt as to the condition of the bridge, the road must be closed pending the outcome of the structural inspection and the completion of any remedial works considered necessary for public safety.

9.02.6 Following a bridge strike at a bridge with a history of strikes, a meeting as described in 7.02 should be set up to determine if any improvements can be made to the signing at or adjacent to the bridge or on the approaches or any other appropriate action that should be taken (See Appendix B).

9.03 At other Rail Authority bridges

Other Rail Authorities will have similar processes to those detailed in 9.02. Examples of bridge identification plates used by London Underground and Northern Ireland Railways are shown in Figures 5 and 6.

Figure 5: London Underground bridge identification plate

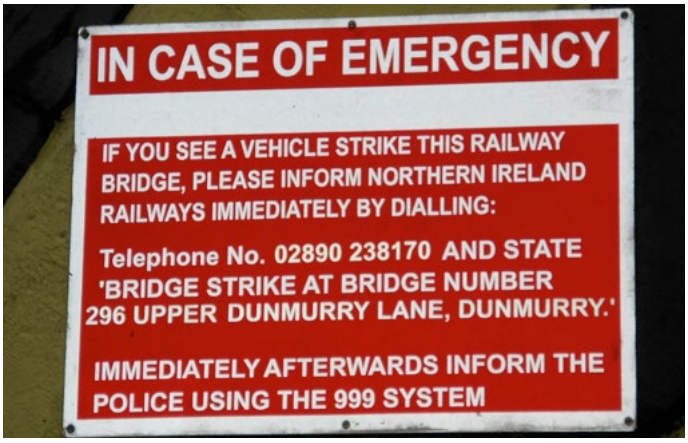

Figure 6: Northern Ireland Railways bridge identification plate

9.04 At a bridge owned by others

9.04.1 In the event of a strike on a bridge owned by others which spans the highway, the bridge owner and the Highway Authority must be contacted immediately. Whether or not the bridge owner responds quickly, the Highway Authority should arrange for the site to be inspected immediately and, where necessary, ask the owner to undertake a structural inspection. In the event that there is any doubt as to the condition of the bridge, traffic on and under it must be stopped pending the outcome of the structural inspection and the completion of any remedial works considered necessary for public safety.

9.04.2 In the event that the bridge is a low signed structure the Highway Authority should inspect the site and make urgent arrangements to repair any damage to traffic signs, surfacing, road markings and lighting, liaising, as necessary, with the bridge owner for access to repair damaged signs attached to the bridge. This should include checking the minimum headroom (see section 2) so as to confirm or amend the dimension shown on the traffic signs.

10 Other useful information

10.01 To understand the risks and consequences of bridge strikes, reference may be made to www.networkrail.co.uk/bridgestrikes which gives details of numbers of reported strikes and lists bridges which have been frequently struck. Information is also provided for the prevention, mitigation and response to bridge strikes.

In addition various guides for the prevention of bridge strikes may be obtained from www.gov.uk/government/publications/prevention-of-bridge-strikes-good-practice-guide.

10.02 The report on research carried out by the Transport Research Laboratory (TRL) commissioned by the Railways Safety & Standards Board (RSSB) 'Reducing the Number and Impact of Railway Underline Bridge Strikes'[17] included 19 findings related to the bridge environment that should be addressed to prevent bridge strikes.

Other findings were related to improvements to static sign and vehicle activated sign products and vehicle operator practices such as route planning.

One of the key results identified that bridge strikes can arise as a result of poor signing for low bridges, including insufficient advance and alternative route signing, incorrect signs, poorly maintained and obscured signs.

The research concluded that a wide range of human errors can lead to bridge strikes, each with a variety of causal factors, and that to prevent bridge strikes a range of issues need to be addressed. These include:

- improvements to the bridge environment, traffic signs and signing schemes, to enable drivers to divert away from the bridge at a suitable location, and to stop drivers from having to make difficult decisions or turning manoeuvres (or in some cases reversing their vehicle back out of roads)
- engagement and co-ordination between the Rail Authority, vehicle operators and Highway Authorities, to encourage development and adoption of procedures and to share information and best practices.

The report may be downloaded from RSSB's information portal, SPARK (search for 'bridge strikes' or 'T854'). Registration for SPARK is required to gain access to the research reports at http://www.sparkrail.org/authentication/pages/register-info.aspx.

17 RSSB Research Programme: Operations and Management: Reducing the number and impact of railway underline bridge strikes: Summary report: Transport Research Laboratory (TRL) August 2012.

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Abbreviations

(See Bibliography for full title of documents)

ADEPT	Association of Directors of Environment, Economy, Planning and Transport
BSPG	Bridge Strike Prevention Group
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
LGV	Large Goods Vehicle
TPO	Tree Preservation Order
TRO	Traffic Regulation Order
TSM4	Traffic Signs Manual Chapter 4
TSM5	Traffic Signs Manual Chapter 5
TSM7	Traffic Signs Manual Chapter 7
TSRGD	Traffic Signs Regulations and General Directions
VMS	Variable Message Signs

Appendix A

Highway repairs under bridges; bridgework over highways

A.1 Highway repairs under bridges

A.1.1 No surfacing works including full depth reconstruction, plane off and inlay, surface dressing or overlay should be undertaken in the vicinity of any bridge without the proposal and its implications being discussed with the Highway Authority's Bridge Engineer and the bridge owner, if different, and their agreements to the proposal obtained. This is due to the potential for uncontrolled reductions in headroom under the bridge to occur leading to an increase in incidences of bridge strikes.

This applies to all bridges, whether a bridge with a maintained headroom less than the standard minimum maintained headroom of 16'6" (5.03m), below which all bridges should be signed, or a bridge with an actual minimum headroom greater than this limit.

The maintained headroom as specified in TD 27[11] Chapter 6 must not be reduced at any time. The difference between the minimum measured headroom with the maintained headroom will determine, along with other local issues, the possibility of overlaying.

A.1.2 Obligations to consult and serve notice under the New Roads and Street Works Act[16] must also be followed for such works.

A.1.3 In any such situation, there must always be a presumption against raising surfacing levels and so reducing headroom. Occasions when this might be allowed are strictly limited and must be controlled by the Highway Authority's Bridge Engineer and agreed with the Rail Authority or other bridge owner.

Rail Authorities do, at certain sites, have a legal obligation to provide a minimum clearance and this must not be compromised by any proposal without formal agreement from all involved parties.

A.1.4 There are potentially very serious implications arising from possible changes in headroom as a result of surfacing work. Checking the available clearance under the bridge must therefore be carried out both before and after surfacing, the latter being before traffic is allowed back on the carriageway, to confirm compliance with the agreed design. If an unsanctioned, unprotected reduction in clearance has occurred, immediate corrective action must be taken before allowing traffic access.

A.1.5 If there is a change in headroom agreed by both parties, especially one which reduces available headroom on signed bridges, the responsibility for changing all related signs at, on and in advance of the bridge, and also on related directional signs to indicate the new signed height for the bridge before traffic is allowed access is vested with the Highway Authority. Signs to diagram 7014.1 (see Figure 2) should be provided at the site for a maximum of six months to advise drivers of the change.

A.1.6 Reductions in clearance under unsigned bridges must at no time reduce the available minimum headroom below that for the maintained headroom for the type of bridge involved.

A.1.7 If work has been undertaken which results in increased headroom, signing must be amended or removed, as appropriate, as soon as possible and again the Highway Authority is responsible for the changing or removing the signs.

A.2 Bridgework over highways

A.2.1 The requirements for consultation and agreement must also be applied to any changes to or planned protection of the structure of a bridge spanning over the highway proposed by the bridge owner. Signing must be checked and corrected before allowing traffic to reuse the road and drivers warned of any lowering of headroom. The bridge owner should meet the costs incurred by the Highway Authority in carrying out this work.

A.3 Bridges with headroom in excess of standard minimum maintained headroom (16'6" (5.03m))

A.3.1 For a bridge deck designed or assessed as able to resist vehicle impact forces, current at the time of the surfacing works, as advised/agreed by the bridge owner, the following criteria should be applied:

a) if existing headroom is more than 3" (75 mm) greater than standard minimum maintained headroom, allow reduction to 3" (75 mm) greater than standard minimum maintained headroom

b) if existing headroom is between 3" (75 mm) greater than standard minimum maintained headroom and standard minimum maintained headroom no reduction should be allowed

c) consideration should be given to increasing headroom where reasonably practicable to 3" (75 mm) greater than standard minimum maintained headroom.

A.3.2 For structures, such as footbridges, assessed as not capable or not known to be capable of resisting current impact forces as advised/ agreed by the bridge owner, the following criteria should be applied:

a) if existing maintained headroom is greater than 17'9" (5.41m) allow reduction to 17'9" (5.41m)

b) if existing maintained headroom is between 17'9" (5.41m) and standard minimum maintained headroom no reduction should be allowed

c) consideration should be given to increasing headroom where reasonably practicable to 17'9" (5.41m) or other headroom more than or equal to 3" (75 mm) greater than standard minimum maintained headroom.

A.4 Bridges with headroom less than standard minimum maintained headroom

A.4.1 There should be a presumption against any reduction in the existing headroom provided under bridges with headroom less than the standard minimum maintained headroom. The Highway Authority and Rail Authority or other bridge owner jointly should determine every case.

A.4.2 When undertaking maintenance work, consideration should be given to improving the situation and especially to seeking ways of providing the standard minimum maintained headroom.

A.4.3 Although there will, in theory, be scope to allow a raising of road surface levels as the signed clearance gives a safety margin between 3" (75 mm) and 6" (150 mm), it is not recommended that such a concession is made because practice has shown that 'regular' drivers' of higher vehicles go through because they know they have managed it before. Such changes could therefore increase the risk of bridge strikes.

A.5 High load routes

No reduction under 20'3" (6.18m) should be allowed.

Appendix B

Additional options for protecting against bridge strikes

In addition to traffic signs and road markings, there are a number of other tools in the kit for protecting bridges from or preventing bridge strikes. They, together with comments, are given below.

B.1 Bridge reconstruction

B.1.1 Reconstructing a bridge can reduce the consequences of a strike should one occur by increasing headroom or removing vulnerable features. It is unlikely that this option will be justified on the grounds of bridge strike risk reduction only. More likely that savings may contribute to the viability of a reconstruction scheme to provide other benefits; e.g. improved carriageway widths and sight lines.

B.1.2. Available headroom may also be improved if the construction depth of the bridge can be reduced.

B.1.3 Care should however be taken when considering increases in headroom as bridges within a particular headroom range may be more susceptible to impact. A review of bridge strikes reported to Network Rail between 1 January 2009 and 31 December 2013 showed that the distribution by signed height in imperial dimensions of bridges involved in bridge strikes (excluding those at which the headroom is not signed) is as shown in Figure B1.

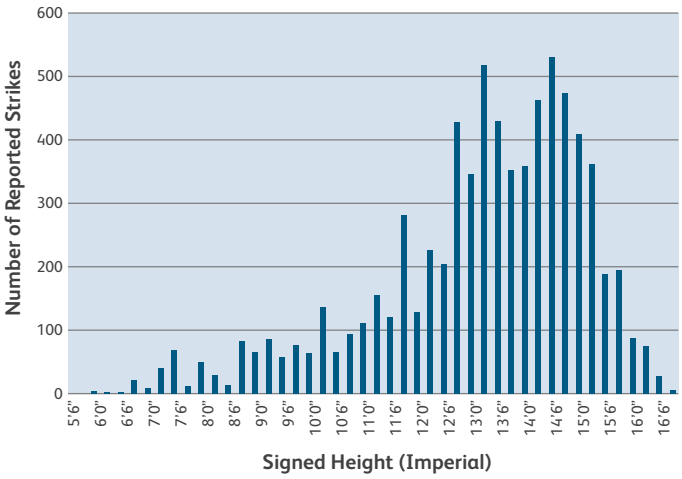


Figure B1: Bridge strikes 2009 – 2013 by Signed Height

There appears to be defined spikes with more strikes occurring at bridges with heights signed at 13'0" and 14'3".

B.2 Collision protection beams (CPBs)

B.2.1 Collision protection beams are installations designed to absorb the force from an impacting vehicle and so protect the structure of a bridge. As such they are generally built into the existing bridge abutments because the Highways Act 1980[18] does not permit free standing supports over the highway as they would create an additional and avoidable hazard to traffic.

B.2.2 Whilst CPBs may be installed under the terms of the Act or other legal agreement covering the original bridge construction, approval from the Highway Authority is also required to protect the interests of the Highway Authority and users of the public highway. This should cover issues of headroom, signing and maintenance access and also the role of the joint signatory in the formal structural technical approval process. A formal licence may be required if a substantive change to the highway is sought or where the proposal is otherwise not compliant with the original legal obligations.

B.2.3 If the bridge is a Listed Building or a Scheduled Ancient Monument or in the curtilage of one, consent from the local Planning Authority will also be needed. If the site is in a Conservation Area, contact should again be made with the local Planning Authority to see if they have any preferences which might be accommodated in the scheme.

B.2.4. Collision protection beams to a flat soffit bridge should be erected between 10 - 20 mm lower than the actual bridge soffit (See BD65[10]) and so the headroom clearance must be rechecked and any necessary adjustments made to the signing before traffic is allowed access under the bridge. The promoter of the protection scheme should allow for and meet the cost of any related re-signing.

18 Highways Act 1980

B.3 Improve bridge soffit visibility

Black and yellow hazard markings should enable a driver to recognise the presence of a bridge which may be a potential hazard by providing a contrast between the soffit of the bridge or abutment and the surroundings.

Black and yellow hazard warning signs (chevrons) to diagram 530.2 should be provided at flat soffit bridges. Retroreflective yellow adjacent to a black background enables the bridge to be visible at night. The hazard warning signs should be used over those parts of the carriageway where the clearance is below 16'6" (5.03m), to give greater emphasis to the restricted height.

B.4 False soffits

The visual appearance of the approach to a bridge with a significant difference in clearance longitudinally under the bridge, either gradually as on an incline, or abruptly where there is an reduction in headroom due to a change in bridge construction, can give the impression to a vehicle driver approaching the elevation that there is sufficient headroom to enable the vehicle to pass under the bridge.

In such cases although a vehicle may pass safely under the approach elevation, there is a risk that an overheight vehicle may become wedged under or significantly damage the bridge at the lower exit side, or collide with the bridge at a change in soffit level.

In such cases, false soffits may be provided to give an impression on the approach of constant headroom under the bridge. They are generally formed by hanging rubber flaps on the elevation to visually match the envelope of the lowest part of the bridge, and have appropriate hazard makings attached. Guidance on the provision of false soffits is given in TSM4[3] paragraphs 7.25 – 7.27.

B.5 Variable message signs (VMS) with height detection equipment

B.5.1 Infra red beams are placed in advance of the bridge and are set at the restricted signed height so that they activate the sign if the beam is broken by an overheight vehicle. The activated sign provides a warning so that the driver of the offending vehicle is given the opportunity to stop and divert.

B.5.2 Sufficient distance is necessary for beam and sign to be located in advance of the bridge both for the sign to respond and for the driver to read and react to its message.

To maximise the effectiveness of VMS through positioning, consider:

- locating the signs in advance of a point where drivers can easily re-route, ideally without having to turn around
- positioning the signs away from junctions, roundabouts or other complex situations and large light sources or distractions

Consideration should be given to whether parking restrictions are required so that neither the sign nor the detector is obscured by parked vehicles.

B5.3 Requirements for the design of VMS (for example: size of text, background, illumination and contrast between background and lettering/lights) are specified in the TSRGD[1] (as amended). The text of the message that will appear on a VMS is prescribed in the TSRGD[1] (as amended).

B.5.4 Infra red beams can suffer from malfunction due to beam misalignment and so it is essential to have a clear default message indicating when the sign is not working. It is recommended that signs are remotely monitored to identify any malfunction.

B.5.5 Each installation should have a robust maintenance contract which includes an emergency response requirement to deal with a malfunction.

B.6 Supplementary signing/white lines

B.6.1 Additional signs may be installed outside exits from factories, warehouses or freight depots where the exit is between the bridge and the last advance warning sign to remind drivers of the direction, distance to and height of a low bridge in close proximity to the exit

B.6.2 Use 'SLOW' painted on the road to increase the driver's ability to stop or reduce the force of a potential impact. The marking is most effective when it complements a warning sign. For advice see TSM5[4]. Alternatively, introduce a lower speed limit if appropriate (See B7.6).

B.6.3 Make a traffic regulation order to introduce a supplementary weight or width restriction to reduce the size of vehicles using the route.

B.7 Other possible considerations

B.7.1 Traffic calming techniques in advance of the bridge.

B.7.2 High containment kerbs or barrier systems may be used to delineate the 'central' lane thereby forcing vehicles to use the safe zone under an arch.

Where high containment kerbs are used, it may be necessary to consider a vehicle wheel mounting the lower lip of the kerb in determining the location of the kerb line and/or signed headroom of the bridge.

High containment kerbs or barrier systems may also be considered as a method to deflect vehicles from a potential impact on columns.

B.7.3 Introduce a yellow box to diagram 1044.2 under arch bridge in conjunction with priority working signs to diagrams 615 and 811. The priority working applies to all traffic all of the time, not just high vehicles using the middle of the road, and thus this method of bridge strike prevention should be limited to arch bridges ordinarily not wide enough to accommodate two vehicles.

The road marking and priority signs should prevent vehicles entering an arch in the opposite direction to an oncoming vehicle, thereby preventing the need for one of the vehicles to swerve and strike the bridge.

B.7.4 A turn round facility provides drivers of vehicles higher than the signed permitted height with the opportunity to turn their vehicles around safely. This is not an option for all bridges, particularly in urban environments as an area of hard standing in the vicinity of the bridge needs to be constructed. Enforcement of waiting and loading restrictions introduced through a TRO may be necessary to prevent unauthorised parking in such areas.

B.7.5 Lower the carriageway to increase headroom. Whilst this is always likely to be the more practical option than raising the bridge, it is also a solution with problems creating, as it does, a sag curve. This increases the depth required to achieve the headroom and causes drainage problems and potential interference with services.

Unless the clearance is increased to above 16' 6" (5.03m) there nevertheless remains a likelihood of a significant bridge strike, particularly if the changed headroom is in the range where more strikes appear to occur (see Figure B1).

B.7.6 Lowering speed limits under or on the approach to the bridge will increase the warning time to a driver when approaching a hazard and thereby reduce the severity of an impact should one occur. This option may be appropriate in conjunction with physical measures to reduce the speed and size of vehicles.

Where a limit of an existing speed restriction is near a low bridge but does not include the road under the bridge, consideration should be given to extending the speed limits to include both approaches to the bridge.

Reference should be made to the relevant guidance:

- *Setting Local Speed Limits*: Department for Transport Circular 01/2013[19]
- *Setting Local Speed Limits in Wales*, Welsh Assembly Government Circular No: 24/2009[20], issued by the Welsh Assembly Government
- *Setting Local Speed Limits: Guidance for Local Authorities*: ETLLD Circular 1/2006[21] issued by Transport Scotland
- *Setting Local Speed Limits In Northern Ireland*[22] issued by the Department of Regional Development (DRD), Roads Service, Northern Ireland.

B.7.7 Install traffic signals to restrict traffic to alternate single line working. This is particularly effective at arch bridges so that vehicles pass under the centre chord and at narrow bridges where there is insufficient width for vehicles to pass each other. Generally, they also have the effect of slowing traffic. An alternative, subject to visibility constraints, could be to introduce full priority working.

B.7.8 Installation of lighting or improvement of relative lighting levels improves the visibility of a potential hazard to a driver and reduces the likelihood of a road traffic collision or impact with the bridge. Lighting obscured vulnerable parts beneath a bridge can be highly effective. This may be beneficial where arch bridges have been widened with adjacent flat decks or beneath structures which are long lengthwise along the road.

B.7.9 The ultimate deterrents are a lorry ban or full closure to vehicular traffic for which a traffic regulation order would be required. This could be either by provision of physical restrictions such as barriers or bollards to prevent misuse, or diversion of vehicular traffic.

B.8 Changes to road layout

B.8.1 At frequently struck bridges consideration should be given to simplifying the road layout on the approaches. For example:

a) removal of visual obstructions which prevent the bridge or signs from being seen on approach

b) improvement of sightlines at junctions on approaches to low bridges to reduce vehicle conflicts and the distraction that this causes. If sightlines cannot be improved consider the use of traffic lights

c) relocating pedestrian crossings away from the bridge.

B.9 Skew bridges

B.9.1 Bridge strikes at skew bridges can cause the vehicle to overturn. In such cases there is a significant risk that, in addition to the risk to the driver of the offending vehicle, an innocent driver of a vehicle passing in the opposite direction or pedestrians could be fatally or seriously injured.

B.9.2 A vehicle might overturn at a skew bridge with or without an impact protection beam. Where vehicles have overturned, the speed of the vehicle appears to have been the main contributory factor and thus mitigation that contributes to a reduction in vehicle speed at the bridge will reduce the risk of a vehicle overturning.

19 Setting Local Speed Limits: Department for Transport Circular 01/2013
20 Setting Local Speed Limits in Wales: Welsh Assembly Government Circular No: 24/2009. October 2009
21 Setting Local Speed Limits: Guidance for Local Authorities: ETLLD Circular 1/2006
22 Setting Local Speed Limits In Northern Ireland: Department of Regional Development (DRD), Roads Service, Northern Ireland. January 2009

Appendix C

Bridge headroom signs and road markings – guidance on inspection report

C.1 The report of an inspection of traffic signs associated with a headroom restriction at a low bridge should include:

- bridge identification
- a map showing the location of the bridge and signs to be inspected
- bridge location
- the signed height(s) on the carriageway(s) under the bridge (if applicable) and date of survey used to determine this height
- list of signs including:
  - locations of signs based on Ordnance Survey co-ordinates
  - name of road in which sign is located
  - type of traffic sign including hazard markings and chord markers and road marking by reference to TSRGD[1] (as amended) diagram number
- information shown on sign including dimensions (metric and imperial)

The scope of the report should include all signs on the bridge, at the bridge and in advance of the bridge, and direction flag signs.

C.2 Specific note should be made of the following:

a) Sign condition including:
- cleanliness
- whether numbers showing dimensions are delaminating
- fading colours or numbers

b) Condition of road markings

c) Vegetation obscuring visibility of the sign or which may do so before the next inspection

d) Visibility of signs to approaching traffic especially from each approach at a junction

e) Presence or otherwise of illumination to the signs, and whether street lamps are provided

f) Functioning of illumination

g) Comment on sign positions and whether the signs should be moved with reason

h) Additional sign(s) considered necessary

i) Condition of supports to signs and fixings to signs on the bridge

j) Compliance with current TSRGD[1] (as amended)

C.3 A sample report form is shown overleaf.

Bridge Headroom/Weight Limit Signs: Inspection Report				
Bridge No.		Bridge Name:		
Bridge location:	Road name:		Road number:	
Inspector:		District/Area:		
Limit Type	Headroom/Weight (delete as applicable)	Imperial		
		Metric		
		Imperial		
		Metric		

Note: This report must cover all signs:

- on the bridge
- at the bridge
- in advance of the bridge including direction flag signs

Record the following:

A	Sign condition	(G/F/P)
B	Condition of road markings	(G/F/P)
C	Vegetation obscuring visibility of the sign or which may do so before the next inspection	(Y/N)
D	Visibility of signs to approaching traffic especially from each approach at a junction	(Y/N)
E	Presence or otherwise of illumination to the signs, and whether street lamps are provided	(Y/N)
F	Functioning of illumination	(Y/N)
G	Additional sign(s) considered necessary	(Y/N)
H	Condition of supports to signs and fixings to signs on the bridge	(G/F/P)
I	Compliance with current TSRGD (as amended)	(Y/N)

G – GOOD F – FAIR P – POOR	Y – YES N – NO

Bridge Headroom/Weight Limit Signs: Inspection Report							
Bridge No.			Bridge Name:				
Bridge location:			Road name:			Road number:	
Inspector:			District/Area:				
Limit Type	Headroom/Weight (delete as applicable)	Imperial		Inspection date:			
		Metric		Date of survey to determine signed headroom:			
Sign Reference	**Sign Location (see map)**		**Sign type (TSRGD Diagram No.)**	**Information on sign**	**Item**	**Condition (G/F/P) or (Y/N)**	**Comments**
	Road name	**OS reference**					
					A		
					B		
					C		
					D		
					E		
					F		
					G		
					H		
					I		
Comment on sign position and whether the sign should be moved with reasons:							

Appendix D

Cleaning traffic signs on railway bridges

D.1 Scope

This Appendix is intended to be used by anyone employed by a Highway Authority working on bridges and structures where a traffic sign is fixed to the structure. The majority of such structures will be owned by Rail Authorities. This is not a complete specification but it may be used in part or full; the responsibility for compliance with safe working and quality management will rest with the contractor or other body engaged to undertake the work.

D.2 Introduction

This Appendix outlines the practicalities and provides suggestions for a safe method of working when carrying out maintenance work on traffic signs fixed to railway bridges, although the principles may be applied to other bridges. The majority of railway bridges are owned by Network Rail but a number belong to regional operators such as London Underground, Northern Ireland Railways or the Tyne & Wear Metro, and some freight lines and heritage or tourist railways are in private ownership.

Following this guidance is not likely to remove the need for a Highway Authority to agree and record a safe method of working with the Rail Authority before works commence but should minimise the associated costs.

D.3 Nature of works

The works undertaken by the Highway Authority should be limited to cleaning and like for like replacement only unless agreed otherwise with the bridge owner. Cleaning includes removal of any vegetation obscuring signs.

D.4 Examples of work

D.4.1 Cleaning, fixing and replacing signs

Signs and chord markers in reasonable condition with surface dirt can be cleaned with soap and water taking care to isolate any electrical connections for lighting. Other cleaning materials can be used provided that the sign will not be damaged or its performance reduced.

Loose signs should be tightened and any missing or damaged bolts and nuts should be replaced. New fixings will however only be allowed with written permission of the bridge owner.

Missing or loose signs and chord markers may be fixed or replaced but the original fixing should be used. In no circumstances should new support brackets be attached to metallic or concrete structures by drilling or welding. New drilled fixings to a masonry structure may only be used with the written permission of the bridge owner.

Non functioning lighting can also be repaired, but where none exist at present new cabling and lighting units should be discussed with the bridge owner before installation.

Figure D1: Sign requiring cleaning or like for like replacement

D.4.2 Vegetation removal

Trees and bushes adjacent to the highway may obscure traffic signs and a decision should be made to either trim branches or remove the offending item altogether to reduce future maintenance. The ownership of the tree or bush should be determined and if not the Highway Authority, it is recommended that Notice is served on the owner of the necessity to trim growth, or work will be carried out by Highway Authority and the owner invoiced accordingly.

Before work to trim branches or fell a tree commences, it will be necessary to check whether a Tree Preservation Order (TPO) applies.

Liaison should be carried out with the bridge owner to remove vegetation growing on the parapet or wing wall with roots on railway property to agree who should carry out the removal of the vegetation.

Vegetation on the bridge structure can have its roots either on the highway or at railway track level. The highway vegetation should be cut back to just above ground level and copper nails driven into the stems to kill the plant. The site should be left free of cuttings and ivy.

Figure D2: Tree branches overhanging the road obscuring the traffic sign

Figure D3: Vegetation on the bridge elevation obscuring the traffic sign

D.5 Safe method of working

D.5.1 Highway related safety issues

Standard safe working procedures for work on the highway should be used. Suitable access plant should be made available (such as hydraulic lifts); working from ladders should not generally be permitted. Traffic management should be appropriate to the location. A full road closure may be necessary where access across the carriageways is required.

Guidance is given in Safety at street works and road works: a code of practice 2013[23] (the red book) which from 1 October 2014 is mandatory on Highway Authorities although not in Scotland.

D.5.2 Railway related safety issues

The appearance of people or mechanical plant and tools above the parapet at a low bridge may cause alarm to drivers of approaching trains. Accordingly the solid part of the bridge elevation will be the limit of work. No plant, tools or parts of the workman's body (including hard hats) should be visible above this line. The removal of vegetation near this top line must also be carried out in a way that minimises movement as seen from trackside as this could also cause alarm.

The limit of work lines are shown below for solid and open parapets.

Figure D4: Solid parapet bridge

Figure D5 - Open parapet bridge

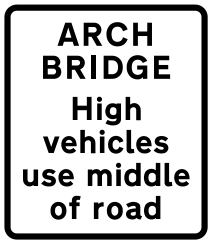
23 Safety at street works and road works: a code of practice 2013: London: TSO

Appendix E

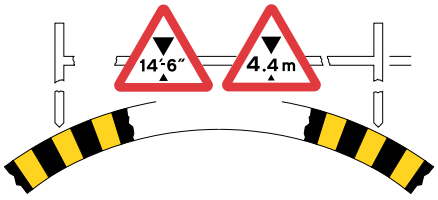
Bridge Audit Check Sheet						
Route identification						
Structure Number						
Bridge Location: **(Road Name / Location)**						
Road carriageway	Dual	Yes/No	Single	Yes/No	One way	Yes/No
GPS location as recorded						
Headroom	[As signed]			[As measured]		
Feet /inches						
Metric						
Date of audit						
Audit By:						

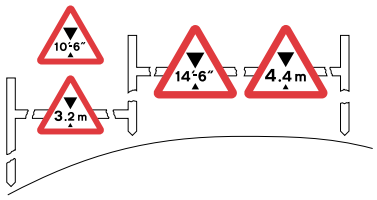
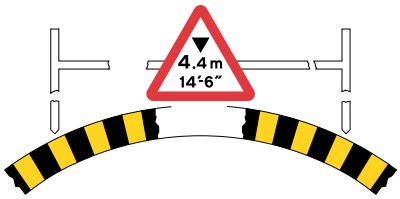
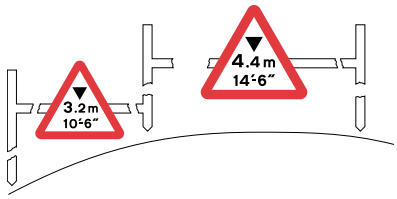
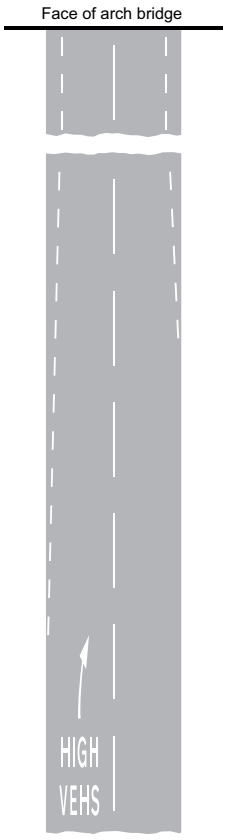
Rail Authority bridge identification plates		
Are two plates erected? Is the Bridge location correctly identified? Where are the plates positioned?	Comments:	
What is the telephone number on the plate?		
Is this telephone number answered by Rail Authority Control?	Yes/No	Telephone number should be: Comments:

Advance signs (diagram numbers are as in TSRGD)		
Are advance signs to enable drivers to take an alternative route avoiding the low bridge provided on all approaches to the bridge?	YES/NO	Comments:
If provided are the signs provided at junctions on all approaches?	YES/NO	Comments:
If provided are the signs in good condition and visible to vehicle drivers? **Consider the following:** **– Cleanliness** **– Damage** **– Graffiti** **– Obscuration**	Comments:	
Are the signs illuminated? **Record whether the sign is internally or externally lit.**	YES/NO	Comments:
Is there unacceptable sign clutter?	YES/NO	Comments:
Should measures be used to make the signs more conspicuous (e.g. rectangular yellow backing boards)?	YES/NO	Comments:

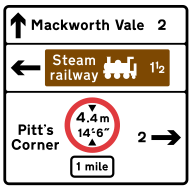
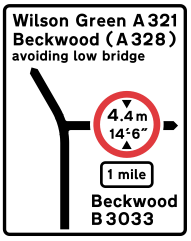
Advance signs (diagram numbers are as in TSRGD)		
What warning or mandatory signs have been used?	**Sign**	**Yes/None**
Diagram 530		
Record whether an imperial sign only or both signs are provided and whether Bridge is an arch or flat soffit Bridge. If present record the distance shown on a supplementary plate.		
Diagram 530A		
Diagram 629.2		
Diagram 629.2A		
Diagram 531.1	 	
Record whether an imperial sign only or both signs are provided		
Diagram 531.2		
Information sign (or variants)		

Signs on or adjacent to the Bridge (diagram numbers are as in TSRGD)		
Are there signs on both sides of the bridge? (one for one way carriageway)	YES/NO	Comments:
Does the signed height at the bridge agree with that shown in the AA Truckers Atlas of Britain? (if applicable)	YES/NO	Comments:
If provided are the signs in good condition and visible to vehicle drivers? **Consider the following:** **– Cleanliness** **– Damage** **– Graffiti** **– Obscuration (vegetation)** **– Condition of chord marking (goal posts) – for arch bridges only**	Comments:	
Are the signs illuminated? **Record whether the sign is internally or externally lit.**	YES/NO	Comments:
Is there unacceptable sign clutter?	YES/NO	Comments:
Should measures be used to make the signs more conspicuous (e.g. rectangular yellow backing boards)?	YES/NO	Comments:
Should an additional warning be provided on the bridge? **e.g. 'LOW BRIDGE'**	YES/NO	Comments:

Signs on or adjacent to the Bridge (diagram numbers are as in TSRGD)		
What warning or mandatory signs have been used?	**Sign**	**Yes/None**
Diagram 530		
Record whether an imperial sign only or both signs are provided and whether Bridge is an arch or a flat soffit Bridge		
Diagram 530A		
Diagram 629.2		
Diagram 629.2A		
Diagram 531.1		
Record whether an imperial sign only or both signs are provided		
Chevrons diagram 530.2		
Hazard and chord marking arch bridge diagram 532.2		
Record whether an imperial sign only or both signs are provided		

Signs on or adjacent to the Bridge (diagram numbers are as in TSRGD)		
What warning or mandatory signs have been used?	**Sign**	**Yes/None**
Chord marking diagram 532.3		
Record whether imperial signs only or both imperial and metric signs are provided		
Hazard and chord marking diagram 532.2A		
Chord marking diagram 532.3A		
What road markings have been used?	**Sign**	**Yes/None**
Lane and road markings - arch bridge (guidance) diagram 1010		
Lane and road markings - arch bridge (deflection arrow) diagram 1014		
Lane and road markings - arch bridge (HIGH VEHS) diagram 1024.1		

Provision of Alternative Route		
Is there a signed alternative route?	YES/NO	Comments:
Is the alternative route suitable for high vehicles?	YES/NO	Comments:
If provided are the signs in good condition and visible to vehicle drivers? **Consider the following:** **– Cleanliness** **– Damage** **– Graffiti** **– Obscuration**	Comments:	
Are the signs illuminated? **(Refer to TSRGD for situations when illumination of signs is required)**	YES/NO	Comments:
Is there unacceptable sign clutter?	YES/NO	Comments:

Provision of Alternative Route		
What warning or mandatory signs have been used?	Sign	Yes/None
Primary route direction signs		
		
		
Non – primary route direction signs		
		
		
Information signs		
		
		

Use of Specific Measures		
Is it appropriate to consider the use of Variable Message Signs (VMS) with infra-red beams? **Consider the following:** **– Use on approach as warning or diversion signing;** **– Location;** **– Functioning correctly;** **– Free from foliage.**	YES/NO	Comments:
Is the use of automatic detection systems (with cameras) appropriate?	YES/NO	Comments:
Is the use of collision protection beams on the bridge appropriate?	YES/NO	Comments:
Could other forms of detection systems be used?	YES/NO	Comments:

General Considerations	
No. of reported strikes in previous 12 months	
Date of last bridge strike	
Amount of LGV traffic passing under bridge. (High, Average, Low)	
Any weight restrictions on the route under the bridge?	

General Considerations	
Adjacent land use. (Industrial, Agricultural, Residential)	
Are there any other low bridges over the same road nearby?	
Could a high sided vehicle manoeuvre, (i.e. turn around) in the vicinity of the bridge?	
General bridge condition, in particular structural weaknesses (ignore paint defects)	
Are there distracting advertisements on the approaches to the bridge?	
Is the lighting adequate for the signs and at the bridge?	
Other General Comments	

Appendix F

Progress reporting of the review, ranking and implementing of improvements to traffic signs at bridges at risk of bridge strikes

Review, ranking and improvement of traffic signs at bridges at risk of bridge strikes	
Date of Signing Review:	Report Date:
Highway/Road Authority:	
Name of Bridge Strike Champion: e-mail address:	
Number of bridges with headroom over the carriageway/s less than 16'6" (signed and unsigned)	
Number of bridges: improvements to traffic signs identified	
Number of new and changed traffic signs to be erected	
Number of bridges: improvements to traffic signs completed	
Number of new and changed traffic signs erected	
Additional comments:	

Rail Bridges Over Roads		
Factor	**Existing Mitigation and Hazards**	**Score**
1 See Note A	**Existing traffic signs per elevation and road markings** • Score 1 for single chord markers with road markings under arch • Score 1 for roundel traffic sign showing height restriction on arch bridge or triangular warning sign on flat soffit bridge • Score 2 for arch chord markers only, no LGV road markings • Score 2 for one or no traffic signs showing height restriction on posts near bridge • Score 4 for no arch chord markings and no LGV road markings • Score 4 for no information signs showing height restriction in advance of bridge • Score 8 for no route direction signs in advance of bridge • Score 12 for: – each continuous white line under an arch – no traffic sign on bridge showing height restriction but minimum bridge headroom less than 16 feet 6 inches – traffic sign for the bridge shows a height restriction more than the measured headroom	
2 See Note B	**Annual number of reported bridge strikes** • Score 1 for no reported bridge strikes • For 3 or less reported bridge strikes score the number of strikes plus 1 • For number of reported bridge strikes ≥ 4 and ≤ 9 score the number of strikes plus 5 • For number of reported bridge strikes ≥ 10 score the number of reported bridge strikes plus 10	
3	**Existing signed height** • Score 1 for ≥ 16 feet or < 10 feet • Score 4 for ≤ 16 feet and ≥ 15 feet 3 inches • Score 10 for ≤ 15 feet and ≥ 12 feet 6 inches • Score 4 for ≤ 12 feet 3 inches and ≥ 10 feet • Score 12 for: – no traffic signs showing height restriction but minimum bridge headroom less than 16 feet 6 inches – traffic sign for the bridge shows a height restriction more than the measured headroom (not otherwise as above)	
4	**Road alignment (horizontal)** • Score 10 for straight road with carriageway ≥ 7.3m • Score 7 for straight with < 7.3m carriageway or curved ≥ 7.3m carriageway • Score 5 if road with carriageway < 7.3m is restricted by an arch bridge • Score 3 for flat soffit bridge over curved road with < 7.3m carriageway • Score 1 for flat soffit bridge over reverse curves with <7.3m carriageway	
5	**Road Alignment (Vertical)** • Score 1 for level or negligible slope • Score 2 for slight but noticeable longitudinal slope • Score 4 for significant longitudinal slope • Score 6 for rising longitudinal slopes at exit from under bridge on both elevations	
6	**Estimated maximum (not signed) speed of approaching road traffic** • Score 2 for ≤ 20mph • Score 3 for ≥ 21 mph ≤ 30mph • Score 5 for ≥ 31 mph ≤ 50mph • Score 7 for ≥ 51 mph ≤ 70mph • Score 9 for > 70mph	
7 See Note D	**Volume of road traffic** • Score 1 for ≤10 LGVs (<200 vehicles)/day (green lane or farm access) • Score 2 for 11 to 100 LGVs (<2,000 vehicles)/day (unclassified) • Score 3 for 101 to 500 LGVs (<7,150 vehicles)/day (C or B class) • Score 4 for 501 to 1,000 LGVs (<12,500 vehicles)/day ('Other Strategic' roads) • Score 5 for over 1,000 LGVs (>12,500 vehicles)/day ('Primary Routes')	

Rail Bridges Over Roads		
Factor	**Existing Mitigation and Hazards**	**Score**
8 See Note A	**Traffic sign visibility and condition** • Score 2 for each traffic sign showing height restriction with visibility obscured or reduced by: – vegetation – dirt and/or grime or graffiti – faded numbers • Score 3 for each non-illuminated traffic sign on street with system of street lighting • Score 4 for each bridge elevation with incomplete, inverted or missing black and yellow hazard marking • Score 5 for each advertising hoarding in the vicinity of the bridge	
9 See Note C	**Site specific hazards increasing event consequences - skew** • Score 1 for skew angle of bridge < 15˚ • Score 2 for skew ≥ 15˚and < 25˚ • Score 5 for skew ≥ 25˚ and < 35˚ • Score 7 for skew ≥ 35˚ and < 45˚ • Score 10 for skew ≥ 45˚	
10	**Site specific hazards increasing event consequences - supports** • Score 2 for masonry or concrete pier • Score 5 for concrete and metallic columns filled with concrete • Score 7 for steel columns • Score 10 for cast iron hollow columns • Score 10 for exposed gas, chemical or other pipeline attached to bridge elevation	
11	**Robustness of bridge** • Score 1 for bridge protected by collision protection beams • Score 1 for masonry arch • Score 1 for concrete bridge • Score 1 for multi track metallic structure • Score 2 for double track metallic structure • Score 4 for single track metallic structure(s) • Score 10 for cast iron arches • For composite form use highest score accordingly to bridge form	
12 See Note E	**Volume of rail traffic** • Score 1 for seldom used route (fewer than 500 trains/year) • Score 3 for lightly used route (501 to 3,000 trains/year) • Score 5 for medium used route (3,001 to 10,000 trains/year) • Score 8 for heavily used route (10,001 to 50,000 trains/year) • Score 12 for very heavily used route (>50,000 trains/year)	
13 See Notes E and F	**Type of rail traffic** • Score 1 for Non-Dangerous Goods Freight • Score 3 for Loco-Hauled stock • Score 5 for Multiple Units (up to 100mph) or Dangerous Goods Freight • Score 7 for Multiple Units (over 100 mph) • Score 11 for Light Rail	
14 See Note E	**Permissible line speed** • Score 1 for straight track < 45mph • Score 4 for straight track ≤ 75mph or curved < 45mph • Score 8 for straight track ≤ 90mph or curved ≤ 75mph • Score 12 for straight track ≤ 100mph or curved up to ≤ 90mph • Score 16 for straight track ≤ 125 mph or curved ≤ 100mph • Score 20 for straight track ≤ 140 mph or curved ≤ 125mph • Score 24 for straight track > 140 mph or curved > 125mph	

Notes for Rail Bridges Over Roads

a) Score should be the total of all that are applicable. For example if there is a roundel only on a flat soffit bridge, score 2 (one or no traffic signs showing height restriction on posts near bridge) plus score 4 (no information signs showing height restriction in advance of bridge) and score 8 (no route direction signs in advance of bridge) = 14 × 2 (2 elevations) = 28

b) Data of number of reported bridge strikes at railway bridges to be provided by the Rail Authority

c) Angle of skew is measured from the perpendicular to centre line of road. For example a bridge perpendicular to the road centre line has a skew angle of 0°.

d) Equivalent traffic flows for all vehicle types may be substituted, depending upon the units of measurement used by the relevant Highway Authority. 'Large Goods Vehicles' includes vehicles with crane attachments and low loaders.

   If the road leads to an industrial complex or similar and is thereby used by a higher LGV traffic volume than average for the class of road, the score should be based on the LGV traffic volume and not the road classification.

e) Data for rail traffic to be provided by the Rail Authority

f) Light Rail includes lightweight passenger trains, Tramways and non-main Line railways. Light Rail does not include preserved railways operating under a Light Railway Order.

Road Bridges Over Roads		
Factor	**Existing Mitigation and Hazards**	**Score**
1 See Note A	Existing traffic signs per elevation and road markings on road passing under bridge • Score 1 for single chord markers with road markings under arch • Score 1 for roundel traffic sign showing height restriction on arch bridge or triangular warning sign on flat soffit bridge • Score 2 for arch chord markers only, no LGV road markings • Score 2 for one or no traffic signs showing height restriction on posts near bridge • Score 4 for no arch chord markings and no LGV road markings • Score 4 for no information signs showing height restriction in advance of bridge • Score 8 for no route direction signs in advance of bridge • Score 12 for: – each continuous white line under an arch – no traffic sign on bridge showing height restriction but minimum bridge headroom less than 16 feet 6 inches – traffic sign for the bridge shows a height restriction more than the measured headroom	
2 See Note B	**Annual number of reported bridge strikes** • Score 1 for no reported bridge strikes • For 3 or less reported bridge strikes score the number of strikes plus 1 • For number of reported bridge strikes ≥ 4 and ≤ 9 score the number of strikes plus 5 • For number of reported bridge strikes ≥ 10 score the number of reported bridge strikes plus 10	
3	**Existing signed height** • Score 1 for ≥ 16 feet or < 10 feet • Score 4 for ≤ 16 feet and ≥ 15 feet 3 inches • Score 10 for ≤ 15 feet and ≥ 12 feet 6 inches • Score 4 for ≤ 12 feet 3 inches and ≥ 10 feet • Score 12 for: – no traffic signs showing height restriction but minimum bridge headroom less than 16 feet 6 inches – traffic sign for the bridge shows a height restriction more than the measured headroom (not otherwise as above)	
4	**Road alignment (horizontal)** • Score 10 for straight road with carriageway ≥ 7.3m • Score 7 for straight with < 7.3m carriageway or curved ≥ 7.3m carriageway • Score 5 if road with carriageway < 7.3m is restricted by an arch bridge • Score 3 for flat soffit bridge over curved road with < 7.3m carriageway • Score 1 for flat soffit bridge over reverse curves with <7.3m carriageway	
5	**Road alignment (vertical) on road passing under bridge** • Score 1 for level or negligible slope • Score 2 for slight but noticeable longitudinal slope • Score 4 for significant longitudinal slope • Score 6 for rising longitudinal slopes at exit from under bridge on both elevations	
6	**Estimated maximum (not signed) speed of approaching road traffic to pass under bridge** • Score 2 for ≤ 20mph • Score 3 for ≥ 21 mph ≤ 30mph • Score 5 for ≥ 31 mph ≤ 50mph • Score 7 for ≥ 51 mph ≤ 70mph • Score 9 for >70mph	
7 See Note D	**Volume of road traffic to pass under bridge** • Score 1 for ≤10 LGVs (<200 vehicles)/day (green lane or farm access) • Score 2 for 11 to 100 LGVs (<2,000 vehicles)/day (unclassified) • Score 3 for 101 to 500 LGVs (<7,150 vehicles)/day (C or B class) • Score 4 for 501 to 1,000 LGVs (<12,500 vehicles)/day ('Other Strategic' roads) • Score 5 for over 1,000 LGVs (>12,500 vehicles)/day ('Primary Routes')	

Road Bridges Over Roads		
Factor	**Existing Mitigation and Hazards**	**Score**
8 See Note A	**Traffic sign visibility and condition** • Score 2 for each traffic sign showing height restriction with visibility obscured or reduced by: – vegetation – dirt and/or grime or graffiti – faded numbers • Score 3 for each non-illuminated traffic sign on street with system of street lighting • Score 4 for each bridge elevation with incomplete, inverted or missing black and yellow hazard marking • Score 5 for each advertising hoarding in the vicinity of the bridge	
9 See Note C	**Site specific hazards increasing event consequences - skew** • Score 1 for skew angle of bridge < 15˚ • Score 2 for skew ≥ 15˚and < 25˚ • Score 5 for skew ≥ 25˚ and < 35˚ • Score 7 for skew ≥ 35˚ and < 45˚ • Score 10 for skew ≥ 45˚	
10	**Site specific hazards increasing event consequences - supports** • Score 2 for masonry or concrete pier • Score 5 for concrete and metallic columns filled with concrete • Score 7 for steel columns • Score 10 for cast iron hollow columns • Score 10 for exposed gas, chemical or other pipeline attached to bridge elevation	
11	**Robustness of bridge** • Score 1 for bridge protected by collision protection beams • Score 1 for masonry arch • Score 1 for concrete bridge • Score 2 for double carriageway metallic structure • Score 4 for single carriage metallic structure(s) • Score 5 for concrete footbridge • Score 10 for cast iron arches • Score 25 for lightweight metallic footbridge • For composite form use highest score accordingly to bridge form	
12	**Type of road carried on the bridge** • Score 1 for C or U road • Score 3 for B road • Score 4 for principal road • Score 6 for primary road • Score 8 for motorway or trunk road	
13	**Principal type of road traffic** • To allow for this factor use score from factor 12. • Where it is known that a non principal road is used by high sided vehicles disproportionately to the class of road, consider increasing score to 4 or 6 as appropriate.	
14	**Permitted speed of approaching road traffic to pass over bridge** • Score 0 for pedestrian bridge • Score 2 for 20mph • Score 3 for 30mph • Score 4 for 40mph • Score 5 for 50mph • Score 6 for 60mph • Score 7 for 70mph	

Notes for Road Bridges Over Roads

a) Score should be the total of all that are applicable. For example if there is a roundel only on a flat soffit bridge, score 2 (one or no traffic signs showing height restriction on posts near bridge) plus score 4 (no information signs showing height restriction in advance of bridge) and score 8 (no route direction signs in advance of bridge) = 14 × 2 (2 elevations) = 28

b) Data of number of reported bridge strikes to be provided by the Highway Authority

c) Angle of skew is measured from the perpendicular to centre line of road. For example a bridge perpendicular to the road centre line has a skew angle of 0°.

d) Equivalent traffic flows for all vehicle types may be substituted, depending upon the units of measurement used by the relevant Highway Authority. 'Large Goods Vehicles' includes vehicles with crane attachments and low loaders.

   If the road leads to an industrial complex or similar and is thereby used by a higher LGV traffic volume than average for the class of road, the score should be based on the LGV traffic volume and not the road classification.

Feedback

Any queries regarding this document should be referred to the Highway Authority's individual bridge strike champion for reporting back to the Bridge Strike Prevention Group member for review by the Group.

The current issue will be held on the DfT, ADEPT and Network Rail websites:

http://www.gov.uk/

http://www.adeptnet.org.uk/

http://www.networkrail.co.uk/bridgestrikes

PREVENTION OF STRIKES ON BRIDGES OVER HIGHWAYS

A PROTOCOL FOR HIGHWAY MANAGERS & BRIDGE OWNERS