small highway structures
DESIGN GUIDE

Guidance notes on the design, approval, construction and adoption of small highway structures within Lincolnshire highways

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1. Introduction

1.1. Lincolnshire County Council, as **Highway Authority** within the County are responsible for the construction, maintenance and repair of the majority of highway structures. Any new structures, additions or alterations to structures located within the public highway network will require the prior approval of Lincolnshire County Council, regardless of present or future ownership.

For the purpose of this document, a highway structure is defined as any item of infrastructure providing either a clear span or retained height of 600mm or greater. This encompasses bridges, culverts (both pipes and concrete boxes), footbridges and retaining walls.

1.2. The management of Lincolnshire highway structures is undertaken by Technical Services Partnership on behalf of Lincolnshire County Council, all correspondence should be addressed to:

   Technical Services Partnership  
   Lincolnshire County Council  
   Witham Park  
   Waterside South  
   Lincoln  
   LN5 7JN

Trunk Roads are controlled by the Highways Agency, and matters relating to these roads must be referred to this organisation.

1.3. These notes are prepared to offer guidance and assistance to external organisations wishing to undertake alterations to existing structures or construction of new structures.

The guidance provides the guidelines for the design and specification of small highway structures. They are not exhaustive and should not be treated as such. They should be read in conjunction with the Lincolnshire County Council “Development Road Layout Guide and Specification” document.

The notes apply in whole to structures to be adopted by the County Council, and in part to structures which carry or support the highway, but are not to be adopted (see Section 10).

1.4. The Construction (Design and Management) Regulations 1997 lay out requirements for clients, CDM co-ordinators and designers to be satisfied as to their **competence** to perform the functions required of them, and to make adequate resources available to meet their duties under **Health and Safety** Statutory provisions.
1.5. All new structures that are adopted as public highway will require a **commuted sum** to be paid to the authority for the future inspection, maintenance and replacement of the structure.

This commuted sum will be calculated to cover the costs associated with the maintenance of the structure over the next 150 years, discounted for the effects of inflation and interest payments, and may be significant compared to the construction cost of the structure. The calculation of this commuted sum will be generally in accordance with CSS guidelines.

1.6. Any changes to the highway layout will be subjected to a **safety audit** process, at both the design and construction stages. This will be undertaken by the Lincolnshire Road Safety Partnership, and any matters arising must be either attended to in the design, or an exception report approved.

1.7. For non-adoptable small highway structures the Highway Authority (the County Council) is more concerned with their **strength and integrity** than their durability.

The basic **design considerations** in section 2 apply, however the requirements with regard to durability may be relaxed. The requirements in other sections which affect the strength and integrity of the structure shall apply.

Aspects of the **Technical Approval** process may still apply (see paragraph 2.3)
2. Design And Technical Approval

2.1. All structures are to be designed and drawn by suitably qualified civil engineers with a working knowledge and experience of the design of highway structures to current standards as referred to in Section 4 below.

2.2. Attention is drawn to the requirement to Construction (Design and Management) Regulations 2007 in relation to assessing the competence of designers, in both individuals and organisations.

2.3. Design methods and procedures for the design of highway structures are provided in the most recently published edition of the Highway Agency Design Manual for Roads and Bridges (commonly referred to as DMRB).

2.4. The technical advice notes and standards contained in this document are adopted by Lincolnshire County Council in their entirety, and further supplemented by other Lincolnshire specific standards detailed in appendix ‘A’ and requirements contained in this document.

2.5. Reference should be made to Lincolnshire County Council policy document HAT34 - Design Standards And Departures For Highway Schemes (Improvements, Maintenance And Developments), which further defines documents and policies relevant to the design of highway infrastructure.

2.6. The status of all Highway Agency published Interim Advice Notes (IAN’s) should be confirmed with the TAA prior to their inclusion within the design.

2.7. Authorisation must be obtained from Technical Services Partnership for all highway structures prior to commencement of construction, including those subsequently offered for adoption. Retrospective approval may not be granted, and in such situations Lincolnshire County Council as Highway Authority may refuse to adopt the structure.

2.8. For non-adoptable highway structures the Highway Authority will decide what part of the Technical Approval process will apply, and this should be confirmed with Technical Service Partnership.

2.9. Where the appropriate published standards are not complied with, a Departure from Standards submission will be required for endorsement by the Head of Technical Services. This submission will require the support of the Structures Group prior to application for endorsement. Details of the Departure from Standards submission process can be supplied by Technical Service Partnership.

2.10. Designs undertaken to building codes of practice and standards (in particular BS8110), will not be approved and will be returned unchecked.
3. Other External Constraints

3.1. In the case of works to be carried out in, over or adjacent to any **watercourse**, the design must also be submitted to any affected drainage authority for approval. Prior agreement must be sought to any attached conditions that may subsequently be transferred onto the County Council. The County Council will require proof that this approval has been granted.

It is considered acceptable for the drainage authority to request the invert of a structure to be lowered by up to 150mm when a structure is reconstructed. Any lowering greater than this is considered betterment and a contribution may be requested.

3.2. Certain species of plants and animals are protected under the Wildlife and Countryside Acts of 1981 and 1991. The promoter must be aware of restrictions this protection may have on undertaking certain works and should dutifully discharge their responsibilities and be able to demonstrate such.

3.3. Many statutory bodies have plant and equipment located within the public highway which may affect the construction or modification works, or affect the final structure. This includes communication services, pipelines, sewers and supplies.

Any such services incorporated into an adopted structure must be installed in such a manner that the service may be replaced without alteration to the associated structure. This is usually achieved with the provision of service ducts and access chambers, extending sufficiently beyond the extents of the structure (including any associated safety barriers).

Consideration should be given to providing additional spare ducts for to allow future services to cross the structure without alteration. This is of particular importance where the distance between the structure and final surface is low.
4. Basic Design Considerations

4.1. The design life for all adoptable highway structures shall be 120 years. The DMRB allows the use of ‘at least 100 years’ for assessing the durability of concrete elements in accordance with BS8500 et al.

4.2. In addition to complying with all appropriate standards listed in appendix ‘A’ the designer must bear the following additional objectives in mind.

- Safe passage for pedestrians and vehicles
- Minimisation of future maintenance costs
- Minimisation of vandalism risk
- Aesthetics and harmony with surroundings

4.3. All highway structures must be designed for both ‘full’ HA loading and a number of units of HB loading in accordance with BD37. Generally, the number of HB units appropriate to the design is as shown below, however this should be agreed with Technical Services Partnership.

<table>
<thead>
<tr>
<th>Category</th>
<th>‘HB’ Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major routes</td>
<td>45 units</td>
</tr>
<tr>
<td>A &amp; B class carriageways</td>
<td>37.5 units</td>
</tr>
<tr>
<td>Other carriageways</td>
<td>30 units</td>
</tr>
</tbody>
</table>

4.4. Design calculations must be checked by an independent person or group prior to submission for approval (see notes on technical approval). An appropriate organisation must be selected based on the category of structure (see BD2). The checked calculations must include a commentary by the checker to indicate the success of the check.

4.5. Particular care is required when designing supporting structures for areas such as footways, verges etc. If there is to be no physical barrier to prevent vehicles from gaining access to these areas, retaining structures must be designed for the appropriate accidental wheel loading or surcharge.

For simple analysis of earth pressures on retaining structures the requirement for the inclusion of HA and HB loading may be replaced with a nominal live load surcharge as BD37/01 paragraph 5.8.2.

4.6. The use of structural elements where the durability is such that they are unable to achieve the required 120 year design life will require the approval of Technical Services Partnership and will result in a significantly increased Commuted Sum being payable.

4.7. All drawings submitted for approval shall have levels related to Ordnance Survey Datum Newlyn (OSDN).
4.8. The requirement to provide **protection for errant vehicles** in the event of an accident should be assessed wherever:

- the highway cross section is altered
- a new hazard is introduced
- works are undertaken in the vicinity of an existing road restraint system which has reached the end of it’s serviceable life

This assessment should be completed using the Highways Agency computerised risk modelling system, the *Road Restraint Risk Assessment Process (RRRAP)* as implemented by TD19 where the enforced speed limit is 50mph or higher and the annual average daily traffic flow exceeds 5000 vehicles per day.

4.9. In situations outside of the scope of the above restrictions, a risk assessment generally in accordance with appendix 2 of TD19 shall be carried out using *Lincolnshire County Council’s Provision Of Vehicle Restraint System (PVRSAS)* data sheet. To obtain this spreadsheet and for guidance on usage, contact Technical Services Partnership.

4.10. Where the PVRSAS is used, the outcome of this assessment must be submitted to Technical Services Partnership for agreement.

4.11. The accident data required for the completion of the PVRSAS is available from:

Lincolnshire Road Safety Partnership
Witham House
The Pelham Centre
Canwick Road
Lincoln
LN5 8HE

4.12. **Minor highway structures** usually include items such as columns, gantries, cantilever masts and high masts for supporting lighting, signs, traffic signals, CCTV, safety cameras, communication equipment and the like.

The design of these structures is covered in detail in BD94.

Depending upon the size and type of these structures, elements of the **Technical Approval** process may need to be followed as outlined in appendix ‘B’.

The need for protecting these structures with an appropriate **vehicle restraint system** must be considered.

Careful consideration must be given to providing access for maintenance and inspection over the life of the structure, for both the owner and the highway authority.
5. Specification

5.1. The Specification for the works shall be the latest published edition of the Specification for Highway Works (commonly referred to as SHW) as part of the Highways Agency Manual Of Contract Documents For Highway Works applied in accordance with the Notes For Guidance On The Specification For Highway Works, as modified below.

5.2. The SHW requires that items such as concrete, waterproofing and backfill are tested by the promoter. Proposals for material testing items and frequency are to be agreed with Technical Services Partnership, and the results supplied in a timely manner.

Failure to either complete the appropriate testing or supply the results may affect the authority’s decision to adopt the structure, and will invariably lead to an increase in the commuted sum payable.

5.3. The specification is further enhanced by the following Lincolnshire County Council specific additions and minimum requirements. The requirements of the DMRB and SHW may exceed this information, in this instance the latter requirements shall be complied with.

5.3.1. Concrete

The minimum requirements for structural concrete shall be:

- Minimum strength class C32/40
- Minimum cement content 325kg/m³
- Maximum aggregate size 20mm
- Maximum free water cement ratio 0.45

Minimum cover to reinforcement shall be 40mm, including pre-cast concrete elements.

Only 1.2mm diameter stainless steel tie wire shall be used for tying reinforcement.

All buried concrete services shall receive 2 coats of an approved below ground waterproofing system.

5.3.2. Parapets

Anti-theft (or anti-vandal) holding down bolts shall be provided at all vehicular and pedestrian parapet post locations. An anti-theft fixing shall be provided for each rail section.

Anti-climb mesh shall be provided on the face of post and rail type vehicular parapets where these are located adjacent to a footway. This mesh shall be attached in such a manner as to facilitate simple replacement.

All steel vehicular parapets shall be painted.
Coping stones shall be mechanically fixed to the adjacent structure.

5.3.3. Paint Systems

All protective paint systems shall be designated for ‘inland difficult access’, with no maintenance up to 12 years, minor maintenance after 12 years and major maintenance after 20 years.

The only colours permitted for protective systems shall be:

- Green 14C39
- Black 00E53
- Medium Grey 00A09

Other colours and all combinations of colours will require the approval of Technical Services Partnership.

5.3.4. Various

Verges shall be hardened over the structure to the extents of the wing-walls or parapet. Half battered kerbs shall be provided where a pedestrian route extends over this hardened verge otherwise splay kerbs shall be provided. Kerbs should be installed at 100mm face height. Positive drainage shall be provided at all kerb faces.

The minimum thickness for any corrugated steel structure shall be 4mm, and shall be both galvanised and provided with a secondary protective coating.

All gabions shall be a minimum of 3.5mm thick wire and shall be PVC and zinc coated. Gabions should be hand packed with care and not machine filled.

Rocker pipes shall be provided on pipe sizes up to 1800mm DIN where a pipeline enters a fixed structure. Stub end pipes shall be used at all ends, cutting of concrete pipes shall not be permitted.

Red indicator mesh shall be installed directly above all bituminous additional protective layers to spray applied waterproofing systems.

The grading requirement for class 6N material shall comply with the requirements for type 1 sub-base material given in table 8/5 in series 800 of SHW. Class 6P material shall not be permitted.

All timber shall be FSC certified. Only the following types of timber shall be permitted: Afrormosia, Afzelia, West African Albizia, Belian, Blackbutt, black Cabbage bark, East African Camphorwood, Curupay African Ebony, Ekki, Greenheart, Guarea, Iroko, Ironbark, Jarrah, Malaysian Kapur, Sabah Kapur, Lapacho, Lignum vitae, Makoré, Mansonia, Mchenga, Muhuhu, Muninga, Nargusta, Okan, Opepe, Andaman Padauk, Burma Padauk, white Peroba, Purpleheart, Pyinkado, Tallowwood, Teak, Rhodesian Teak, Turpentine, Wallaba

Construction tolerances shall be as appendix ‘C’
6. Culverts

6.1. **General**

6.1.1. The **length of culvert** required will be dictated by the site geometry. Generally the length must be sufficient to provide level verges of not less than 2 metres width on each side of the carriageway. In some cases it may be preferable to increase the culvert length to facilitate sloping batters (slope 1:1.5 maximum) and hence reduce the size of headwalls required, or to construct revetments.

6.1.2. The **length of headwall / wingwalls** must be sufficient to accommodate a 1:1.5 batter from watercourse bed level at the side of the culvert to verge level at the wall end.

Vertical headwalls and wingwalls should be designed as free standing retaining walls in accordance with section 7. Wingwalls may be parallel to the carriageway or splayed to suit the site topography.

As an alternative to vertical headwalls, it may be possible to support the ground above the structure using a revetment. These are generally constructed, to a maximum height of 2m, using broken kerbs and angled at a maximum of 45°. Stone pitched or sandbag revetments are not acceptable.

6.1.3. In the vicinity of the wing-walls, consideration should be given to the **prevention of scour** of the bank slopes, particularly where construction work causes removal of the natural protection provided by established vegetation and root systems.

This can be achieved with suitable revetments, gabions or inclusion of reinforced soil bank slopes.

6.1.4. The culvert headwall and adjacent watercourse should be assessed for the need to **provide vehicular containment**. Where vehicular containment is necessary, this should be provided in accordance with section 9.

6.1.5. In locations where the appropriate risk assessment indicates that vehicular containment is not required, but a pedestrian route is present a **pedestrian parapet** will be provided.

The presence of a cycleway or equestrian route will require an appropriate increase in the height of the parapets.

Where there is no clear pedestrian route (neither a metalled footway nor route of a public footpath) a white painted hardwood timber post and two rail fence may be provided to delineate the headwall location.
As a general rule however in urban or residential locations all drops will require either a vehicular or pedestrian parapet.

6.1.6. If parapets or safety barriers will cause an obstruction to visibility to either vehicles travelling along the highway or vehicles emerging from junctions or accesses the culvert must be lengthened to provide **wider verges**. Visibility may be provided over safety barriers but may not be justified through either post and rail or vertical infill parapets.

6.2. **Pre-cast Concrete Box Culverts**

6.2.1. The **design standard** for buried concrete box type structures is BD31. Pre-cast box culvert units are generally designed by the manufacturer, to the particular intensity of highway loading appropriate to the class of road. The depth of the culvert below finished road level (F.R.L) must be considered to determine the appropriate loadings:

(a) Depth from F.R.L. to top of culvert unit less than 0.6m:

- HA loading shall consist of the HA UDL / KEL combination, no dispersion either load shall be applied
- HB loading appropriate to the road classification shall be considered, dispersed through the fill surfacing material

(b) Depth from F.R.L. to top of culvert unit 0.6m or greater:

- The appropriate HB loading only shall be applied

Account shall also be taken of a dispersed single 100kN HA wheel load where this has a more severe effect on the structure than the loads described in (a) or (b) above.

6.2.2. Pre-cast concrete box culvert units on salted routes must be designed for exposure classes XC3 and XD2, otherwise an exposure class of XC3 may be provided.

6.2.3. The **bedding** for the units is to be in accordance with Clause 6.2.3 of BD31. Specific consideration should be given to the bedding for the units above a headwall base slab.

6.2.4. If the **end units** are to be visible on the completed structure façade, F4 finish fair faced ends should be provided. The box culvert units should be jointed and sealed with an approved low compressibility bitumen jointing compound, such as Tokstrip.

6.2.5. The top and sides of the units must be waterproofed with a proprietary approved **waterproofing** system down to a level 200mm below the structure soffit and up 100mm onto the headwall, wing-wall or parapet plinth. A protective layer shall be provided to the waterproofing system.
6.2.6. **Backfilling** adjacent to the units is to comprise suitable granular fill to Clause 610 of the Specification, however **only class 6N material** shall be permitted. This material shall be laid and compacted in accordance with the Specification.

6.2.7. Fill material **within 450mm of the finished surface**, including pavement and road level is to be non-frost susceptible granular sub-base material Type 1.

6.2.8. Where it is a requirement for the interior of the culvert to be dry, a drainage system to reduce **pore water pressure** on the rear face of the box culvert should be provided. Otherwise this may be omitted.

6.2.9. Consideration must be given to the weight of pre-cast concrete box culvert units with respect to the **size of crane required** for installation.

6.3. **Pre-cast Concrete Circular Pipes**

6.3.1. Circular reinforced concrete pipes suitable for installation beneath highways are to be **strength class 120**. Care must be taken to ensure the appropriate crushing loads provided in BS5911 are used in the pipe design.

6.3.2. **Loading** on pipes can be determined from “**Simplified Tables of External Loads on Buried Pipelines**” published by HMSO in 1986.

6.3.3. Guidance on **bedding and surround** to pipes of different sizes (up to 900mm) and strengths is given in Department of Environment, Transport and Regions Advice Note HA 40.

6.3.4. Circular concrete pipes **greater than 900mm diameter and having depth of cover greater than 0.6m but less than 10.0m must be designed to Highways Agency Standard BD82 ‘Design of Buried Rigid Pipes’**.

6.4. **Corrugated Steel Buried Structures**

6.4.1. Corrugated steel structures shall not be installed within 10 miles of the coast, or wherever other climatic conditions may affect their longevity.

6.4.2. The **suitability** of this type of culvert depends on the depth from finished road level to soffit, which must exceed 0.65 metres or 1/5th span (whichever is greater). They are not acceptable in locations where the pH value of the **groundwater** is less than 4.5 or exceeds 9.

6.4.3. They are usually designed by the manufacturer and to the particular intensity of highway loading appropriate to the class of road. **Design and installation** of corrugated structures must be in accordance with BD 12. Highway **loading** as specified in BD 37 is to be applied to all culverts over 0.6 metres span/diameter.
6.4.4. The **durability** requirements are set out in Chapter 8 of BD 12. In the absence of appropriate soil/fill tests the Classification of the Atmospheric Environment (Table 8) and the Corrosivity Classification of the water or effluent (Table 7) shall be taken as “aggressive”.

6.4.5. The design must assume that no **maintenance repainting** of the culvert will be carried out and the inside face is therefore designated “inaccessible”.

6.4.6. The minimum requirements for excavation, bedding and surround of the structures are given in Chapter 9 of BD 12.

Note that care must be exercised to ensure an **even distribution of load** to either side of the structure when backfilling.

6.4.7. In the absence of an appropriate ground investigation report the **trench width** shall not be less than three times the span or diameter, the maximum value of Constrained Soil Modulus used in the design shall be 20MN/m² and the backfill shall be compacted to not less than 85% of maximum dry density.

6.4.8. In cases where the pipe is being laid beneath an existing carriageway and the subgrade material is cohesionless, the **trench width** can be reduced to the minimum required by Clause 9.5 of BD12, the design value of Constrained Soil Modulus can be taken as up to 33MN/mm² and the backfill shall be compacted to not less than 90% of maximum dry density.

6.4.9. The **finishes** to the inner and outer surfaces of the structure must be galvanised/aluminised and provided with a secondary protective coating by the manufacturer prior to delivery.

6.4.10. For structures carrying water or effluent **invert protection** shall be provided using an appropriate method from Clause 8.16 of BD12/01 to protect against the effects of abrasion/erosion.

6.5. **Plastic Pipes**

6.5.1. For circular culverts **not exceeding 900mm diameter** with a minimum cover of 1.5m on unclassified and ‘C’ class carriageways, a plastic pipe of minimum ring stiffness 6kN/m² with BBÂ certification for use as a highway drainage may be provided as a permanent former for a structural concrete bed and surround.

6.5.2. Care must be taken to **prevent uplift when pouring the concrete around the pipe**. This is usually achieved by strapping down the pipe at regular intervals. Justification will be required for the strength capacity of the holding down straps.

6.5.3. The concrete surround must comply with the minimum requirements for structural concrete given in section 5 above, and must extend a minimum of 300mm or span/2 each side of the external face of the pipe and 500mm above the pipe.
7. Retaining Walls

7.1. Design and construction requirements for backfilled retaining walls are given in BD30.

7.2. Highway retaining structures may be required to perform one of two basic functions:

(a) To retain ground which is elevated above the highway and not carrying highway loading.

(b) To retain the highway above lower adjacent areas (e.g. wing-walls to culverts). In this case the wall must be able to withstand horizontal ground pressures imposed by traffic loading.

7.3. Any retaining wall within 3.65m of the public highway with a height of greater than 1.35m will require the approval of Lincolnshire County Council (under section 167 of Highways Act 1980)

7.4. Retaining walls will frequently be of the ‘inverted T’ form and may be constructed of either mass concrete, reinforced concrete or brick. Other structural forms such as crib walls or reinforced earth may be acceptable if designed and constructed in accordance with all relevant standards.

7.5. Retaining walls must be designed to provide adequate stability against combinations of ground forces, any possible traffic loading and vehicular impact.

7.6. The minimum factor of safety shown below must be provided against both sliding and overturning. If vehicular parapets are provided, horizontal impact loads must be considered in assessing overall stability.

<table>
<thead>
<tr>
<th>Load Combination</th>
<th>FOS Sliding</th>
<th>FoS Overturning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1 + 2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1+ 2 +3</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Appropriate active and passive earth pressure coefficients should be used in the stability analysis.

Careful consideration should be given to any future excavation removing a restraining effect, as a minimum the relieving effect of any fill material within 0.5m vertically of the final surface should be ignored.
7.7. In designing the integrity of structural elements (i.e. bending and shear) the forces due to earth pressures should be calculated using an appropriate coefficient for **earth pressure at rest** (see BS 8002 ‘Code of Practice for Earth Retaining Structures’).

Where a retaining wall stem forms the supporting member for a parapet it should be designed for parapet loading in addition to traffic loading and lateral earth pressures.

The structural analysis must consist of a limit state design, considering both the ultimate (ULS) and the serviceability (SLS). The appropriate **partial factors** $\cdot f_l$, $\cdot f_1$, $\cdot m$ must be applied for each condition.

7.8. The design must demonstrate resistance to **early thermal shrinkage** of immature concrete elements in accordance with BA24.

7.9. Adjacent to the wall **retained material** is to comprise suitable granular material to Clause 610 of the Specification for a minimum distance of 600mm from the wall and is to be fully compacted in layers in accordance with the Specification.

7.10. Where the length of wall exceeds 5 metres, consideration must be given to the provision of **joints** to accommodate shrinkage and small relative displacements due to settlement.

7.11. Retaining structures should incorporate suitable **weep holes** to relieve pore water pressures.

7.12. Concrete retaining walls below carriageway level on non-salted routes may be designed for exposure class XC3, otherwise exposure classes of XC3 / XD2 must be used. All concrete retaining walls above carriageway level must be XD3.

7.13. Consideration should be given to the appearance of concrete walls in urban and residential environments, where the use of brick cladding may be appropriate. Where brick cladding is provided, this should be attached to the supporting structure with stainless steel fixings and any void filled with the appropriate mortar.
8. Footbridges

8.1. The span of the footbridge required will be dictated by the site geometry. The provision of central supports (piers) shall be assessed on the basis of safety, appearance and economics; generally, a single span will provide the optimum solution.

8.2. The design criteria for footbridges are laid out in BD29. The enhanced criteria in Clause 14.2 of BD29 will be adopted, so that the footbridge may be used by disabled people. The footbridge and its constituent parts (deck, parapets, ramps, stairs and supports) must be designed to carry the loads given in Section 7 of BD37.

8.3. Structural steel is to be protected with an appropriate paint system, see section 5.

8.4. “Very Durable” structural timber (as stated in Building Research Report No. 296) to BS5756 and BS5268 Part 2 Grade Stress SC8 is required, from sustained sources. Grade Stresses shown in Table 9 of BS5268 Part 2 must be employed for the design of timber elements.

8.5. Timber is to be planed on all sides with the exception of deck boards. Parapet posts and handrails are to be “Pencil Rounded” at the corners.

8.6. In “moderate use” situations deck boards will have anti slip grooves machined in the saw cut face the remaining three faces being planed. In “heavy use” situations deck boards will require an epoxy resin bauxite chipping type system, or similar approved system.

8.7. The presence of a cycleway or equestrian route will require an appropriate increase in the height of the parapets. Consideration must be given to items being deliberately thrown from the footbridge onto the area below.

8.8. Any services are to be carried by the footbridge in a manner which gives the minimum possible visual impact.
9. Road Restraint Systems

9.1. The distance between the inside faces of safety barriers or parapets must not be less than 6.5 metres.

9.2. Where the appropriate risk assessments require the provision of vehicular containment, this may be provided by either a parapet attached to the structure, or a separate safety barrier. A safety barrier does not provide protection for pedestrians, and a further pedestrian barrier will be required.

9.3. Safety barriers and vehicle parapets are designated vehicle restraint systems and the requirements for these items are given in TD19.

9.4. The containment level and length of need of a vehicle restraint system required on the approach and departure to hazard are given by the RRRAP computer programme, subject to a minimum requirement specified in TD19.

9.5. Vehicle restraint systems are specified with a working width criteria. This working width is measured from the traffic face of the barrier and must be clear of other obstructions, for a parapet the working width may extend clear of the structure plinth.

9.6. The provision of crash cushions will require the approval of Technical Services Partnership, and may only be utilised in exceptional circumstances.

9.7. Metal parapets will require mounting on a suitable concrete plinth arrangement, for vehicle parapets this will need to be a minimum of 500mm width. Concrete parapet plinths must be designed for exposure class XD3. As an alternative to the requirements of BD43 for impregnation, the plinth may be constructed using strength class C40/50 concrete.

9.8. A parapet will require a safety barrier to be installed at both ends, with an approved transition between the systems. The transition length is included in the length of need, but generally will exceed the minimum departure length.

9.9. Terminals shall be provided at each end of a safety barrier. For roads with a speed limit of 50mph or higher a class P4 energy impact absorbing terminal is required, otherwise a class P1 terminal may be provided.

9.10. Only vehicle restraint systems listed in latest publication of the Highways Agency ‘HA Accepted EN1317 Compliant Road Restraint Systems’ document will be permitted.

9.11. Aluminium parapet systems shall not be permitted in rural locations without prior approval from Technical Services Partnership.
9.12. Pedestrian parapets may be of steel construction with vertical infill and must comply with BS 7818. As an alternative a vertical brick wall of not more than a single brick (215mm) thickness may be provided and should have an appropriate stone or concrete coping.

9.13. Steel pedestrian parapets shall be both galvanised and painted in an appropriate colour in urban environments, elsewhere these parapets may be galvanised only.
10. ‘As Built’ Drawings & Maintenance Manual

10.1. A "Health and Safety File" in accordance with The Construction (Design and Management) Regulations 2007 will be required for all work affecting structures on the public highway. Typically this would include:-

(a) a brief description of the work carried out, including key structural principals and design criteria;

(b) any residual hazards and details of any hazardous materials used;

(c) information regarding demolition or dismantling of the structure or installed equipment;

(d) 'as-built' drawings

(e) general details (including manufacturers and suppliers) of materials used and methods of construction;

(f) details of equipment and parts which require maintenance, including operating and maintenance procedures; and

(g) details of the location and nature of utilities and services.

10.2. A separate health and safety file must be prepared for each structure.

10.3. The adoption of any structure will not be approved without the provision of an accepted Health And Safety File.

10.4. On completion of a project or structure, the client is required by the Regulations to store the Health and Safety File for the purposes of any future maintenance or repair schemes. If the client's interest in the structure is passed to another body (e.g. if the Council adopts the structure) the Health and Safety File shall also be transferred.

10.5. If the structure is non-adoptable, then the County Council requires a copy of the as-built drawings of all highway structures for its records.
Note: These lists are not exhaustive and do not contribute a Technical Approval schedule

The Design Manual for Roads and Bridges (including BA, BD, HA, HD, TA, TD, IAN) and Manual Of Contract Documents for Highway Works (including SHW, NiGSHW, HCD) are available at www.standardsforhighways.co.uk

For technical approvals

BD 2 Technical Approval of Highway Structures

For general design and loadings

BD 29 Design criteria for footbridges
BD 30 Backfilled retaining walls and bridge abutments
BD 31 Buried concrete box type structures
BD 37 Loads for Highway Bridges
BD 74 Foundations
BD 82 Design of Buried Rigid Pipes

BS 5400 pt.2 Specification for loads
BS 8002 CP for Earth Retaining Structures
BS 8004 Foundations

Simplified Tables of External Loads on Buried Pipelines

For material specific properties

BD 12 Corrugated steel buried structures
BD 13 Use of BS 5400 Part 3: 1982
BD 24 Use of BS 5400 Part 4: 1990.
BD 28 Early Thermal Cracking of Concrete
BD 47 Waterproofing and surfacing of bridge decks

BS 5268 Structural Use of Timber
BS 5911 Specification for reinforced concrete pipes
BS 5400 pt.3 CP for design of steel bridges
BS 5400 pt.4 CP for design of concrete bridges
BS 5628 Un-reinforced masonry
BS 8500 Concrete method of specifying
BS 7818 Pedestrian restraint systems in metal

For highway design and safety barriers

TD 27 Cross-sections and Headroom
TD 19 Road Restraint Systems
TD 9 Highway Link Design

BS EN 1317 Safety Barriers
Other useful documents

Good Bridge Detailing Guide

BS8666 Scheduling ….. Reinforcement

HA Accepted EN1317 Compliant Road Restraint Systems
(available from www.highways.gov.uk)

Road Restraint Risk Assessment Process
(available from www.highways.gov.uk. Note: The latest version must be downloaded each time before use)

CSS - Commuted Sums for Maintaining Infrastructure Assets Guidance Document
(available from www.cssnet.org.uk)

Lincolnshire County Council Documents
(Available on request)

HAT34 Design Standards And Departures For Highway Schemes
(Improvements, Maintenance And Developments)

HAT40 Commuted sums for Maintenance

HAT51 Provision Of Vehicle Restraint Systems (& PVRSAS)

HAT63 Safety Audits Policy and Guidance

DPD33 Traffic Management Act 2004 – Registration of Works and Road Space Booking System

Standard Drawings and Typical Details
(available from www.lincolnshire.gov.uk)

The Manual Of Contract Documents for Highway Works

Specification for Highway Works
Notes for Guidance on the Specification for Highway Works
Highway Construction Details
Appendix B - Technical Approval Requirements

All highway structures will require technical approval in accordance with BD2. Each structure type is allocated a category (0, 1, 2 or 3) which defines the technical approval requirements for the structure. Technical Services Partnership will act as TAA.

BD2 gives guidance on selecting a category appropriate for the type of structure proposed. The category of a structure should be agreed with Technical Services Partnership prior to the commencement of detailed design. The category of the structure may change as the design evolves.

A structure that does not conform to published standards is either a category 2 or 3, this includes requirements for safety barriers and parapet provision. Note: use of the PVRSAS for situations beyond the scope of the RRRAP does not contribute a Departure from Standards.

The Approval In Principal process may be the appropriate method for endorsing Departures From Standards, otherwise a separate Departure from Standard submission will be required.

The following design certification will be required, and must be submitted with full design documentation as described below:

For all structures a Design Certificate will be required for endorsement by the TAA.

For structures categories 1, 2 or 3 an Approval In Principal will be required, including a Technical Approval Schedule. This shall be completed and submitted to the TAA together with all necessary drawings and other documents for agreement or amendment.

For category 2 and 3 structures a Check Certificate will also be necessary for TAA endorsement. Category 3 structures require this check to be completed by an independent organisation.

The documentation accompanying the Design and Check Certificates shall comprise a full set of construction drawings and full structural calculations written out in sufficient detail as to be easily followed by a competent engineer and including:

- Statements of principles employed in analysis
- Clear references to clauses of relevant design standards
- Diagrams and sketches as required for clarity
- Input data for any computer program utilised
- Computer output marked to indicate results used in the calculations and design.
Appendix C – Construction Tolerances

Maximum acceptable construction tolerances \((Y_1)\) are specified as below:

![Diagram of deviation / tolerance relationship](image)

<table>
<thead>
<tr>
<th>LINE TOLERANCE</th>
<th>Given Line</th>
<th>Maximum deviation from line on</th>
<th>Maximum between units</th>
<th>Other requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10m chord</td>
<td>20m chord</td>
<td>3m straight</td>
</tr>
<tr>
<td>Walls, vertical or horizontal</td>
<td>± 7 mm</td>
<td>7 mm</td>
<td>7 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>Soffit edges</td>
<td>± 7 mm</td>
<td>10 mm</td>
<td>7 mm</td>
<td>5 mm</td>
</tr>
<tr>
<td>Copings</td>
<td>± 10 mm</td>
<td>5 mm</td>
<td>3 mm</td>
<td>± 7 mm over complete length being over 30m</td>
</tr>
<tr>
<td>Parapet plinths</td>
<td>± 10 mm</td>
<td>5 mm</td>
<td>3 mm</td>
<td></td>
</tr>
<tr>
<td>Footways</td>
<td>± 15 mm</td>
<td>10 mm</td>
<td></td>
<td>Width ± 7 mm</td>
</tr>
<tr>
<td>Channels</td>
<td>± 15 mm</td>
<td>10 mm</td>
<td></td>
<td>Width ± 5 mm</td>
</tr>
<tr>
<td>LEVEL TOLERANCE</td>
<td>Given Levels</td>
<td>Max. deviation from line 10m chord</td>
<td>Max. deviation from line 3m straight</td>
<td>Maximum between units</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------</td>
<td>------------------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Abutments, pier tops, crossheads –normal to span</td>
<td>± 7 mm</td>
<td>5 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abutments, pier tops, crossheads - parallel to span</td>
<td>± 7 mm</td>
<td></td>
<td></td>
<td>± 3 mm across width</td>
</tr>
<tr>
<td>Beam soffit</td>
<td>± 7 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deck concrete</td>
<td>± 10 mm</td>
<td></td>
<td>10 mm</td>
<td></td>
</tr>
<tr>
<td>Copings</td>
<td>± 10 mm</td>
<td></td>
<td>5 mm</td>
<td>2 mm</td>
</tr>
<tr>
<td>Parapet plinths</td>
<td>± 10 mm</td>
<td></td>
<td>5 mm</td>
<td></td>
</tr>
<tr>
<td>Channels, footways</td>
<td>± 10 mm</td>
<td></td>
<td>7 mm</td>
<td></td>
</tr>
</tbody>
</table>