Lincolnshire COUNTY COUNCIL

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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Lincolnshire COUNTY COUNCIL

SMALL HIGHWAY STRUCTURES

Design, Construction & Technical Approval Guidance Notes

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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 through 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
County Offices,
Newland,
Lincoln
LN1 1YL

Trunk Roads are controlled by National Highways, 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 and Sustainable Drainage Specification and Construction"* 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.

The Construction (Design and Management) Regulations 2015 lay out requirements for Clients, Principal Designers and Principal Contractors 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.

1.4. It is expected that all new structures within the public highway will be adopted by the Highway Authority for maintenance at the public expense. The Highway Authority will adopt any structures in their entirety.

1.5. All new structures that are adopted as public highway shall 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 ADEPT guidelines.

1.6. 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 2.9)

1.7. Any changes to the highway layout shall 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.

1.8. Generally new **privately owned structures will not be permitted** within the public highway. Ownership by private individuals, companies, associations, trusts and the like will not be accepted. The exceptions to this may be:

- Organisations both enabled by statute and anticipated to exist in perpetuity – notably rail, canal, or Land Drainage authorities and the like;
- Statutory Undertakers within the scope of the New Roads and Street Works Act 1991;
- Private companies where the structure is solely for the purpose of their business, with an agreed finite lifespan and decommissioned after use.

1.9. For all works executed under Section 278 Highways Act 1980, the proposed design will be **'accepted'**. For all works executed under Section 38 Highways Act 1980, the design will be **'approved'**. All references to 'approval' in this document should also be deemed to include design 'acceptance' where appropriate.

*1.10. It should be noted that the following **terminology** is used in this document: '**must'** indicates a statutory requirement; **'shall'** indicates a Highway Authority requirement, **'should'** indicates advice expressed as a recommendation, '**may'** indicates advice expressed as a permissible approach.*

2. Design And Technical Approval

2.1. All highway structures must 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 requirements of the *Construction (Design and Management) Regulations 2015* in relation to assessing the competence of designers, as both individuals and organisations.

2.3. A pre-submission discussion with Technical Services Partnership is encouraged to assist in an efficient and timely approval and avoid the need for repeated revised submissions. To arrange, please contact: 01522 782070 or developmentmanagement@lincolnshire.gov.uk

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

2.5. 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.

2.6. 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.

2.7. The status of all National Highways published Interim Advice Notes (IAN's) shall be confirmed with the TAA prior to their inclusion within the design.

2.8. 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.

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

2.10. Where the appropriate published standards are not complied with, a Departure from Standards submission shall be required for endorsement by LCC's Infrastructure Commissioner.

This submission will require the support of Technical Services Partnership prior to application for endorsement. Details of the Departure from Standards submission process are available from Technical Services Partnership.

2.11. Designs undertaken to building codes of practice and standards will not be approved and will be returned unchecked.

2.12. Any intended revisions subsequent to design approval proposed following commencement of works on site shall require the formal approval of Technical Services Partnership.

2.13. A checklist of documents potentially required for a full design submission for approval is available in Appendix F.

2.14. The structure must be located wholly on the public highway, or land to be dedicated as such on completion.

A **minimum 3m easement** for future maintenance and replacement will be required from the extents of all structures (including any foundations) outside of the adopted highway.

2.15. Temporary works affecting the safety and integrity of the public highway or highway users may require formal approval before commencement.

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 shall 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 may be considered betterment and a contribution 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.

3.4. 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).

3.5. Consideration should be given to providing additional spare ducts 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.

It would be unusual for a new structure not to contain a generous number of spare ducts to facilitate installation of additional or alternative buried services in the future.

Ducts should be provided in a range of sizes sufficient to allow statutory undertakers to place their ducts inside of these if desired. A minimum duct size of 150mm internal diameter would be expected.

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
- Prevention of flooding

4.3. Highway structures will be **adopted in their entirety** included all buried elements, and headwalls, wing walls, revetments and the like.

4.4. Any connections to 3rd party private structures shall require the **explicit agreement** of Technical Services Partnership and the third party. Clear delineation of liability must be incorporated into the design.

4.5. The design must consider the eventual replacement of the structure, and the effect of these works on local businesses and residents. If an alternative access route is unavailable, the width of the structure may need to be increased to facilitate the replacement with vehicle access maintained continuously along the route during these works.

4.6. All structural analysis must be undertaken in accordance with the Bridges parts (usually designated "**Part 2**") of the **EUROCODES**; and all associated UK *National Annexes* and *Nationally Determined Parameters (NDP's)*, *Non-Contradictory Complementary Information (NCCI)*, and related *Published Documents (BS EN's)*.

4.7. It should be noted that Eurocodes were introduced for UK highway bridge design from 31 March 2010.

4.8. All products intended for inclusion or use in the works must comply with the associated European Product Certification Scheme where appropriate.

4.9. All structural analysis must be undertaken using the partial factor methodology, with the exception of the demonstration of resistance to overturning and sliding of gravity retaining walls (including headwalls) which may continue to use the global factors outlined in para. 7.6

4.10. Highway vehicle loading must be applied to all areas of the structure as an adverse action.

4.11. All highway structures shall be designed for vehicle actions (LM1 and LM2) applied to all parts of the structure, including elements remote from the carriageway.

4.12. Generally, the LM3 model may be applied only to the carriageway area and applied as appropriate to the design as is shown below, however this should be agreed with Technical Services Partnership.

Category	LM3 Vehicle
Major routes	SV80 SV100 SV196
A & B class carriageways	SV80 SV100
Other carriageways	SV80

4.13. 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 CG300).

The checked calculations must include a **commentary by the checker** to indicate the success of the check.

4.14. 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 actions or surcharge.

4.15. For simple analysis of earth pressures on **retaining structures** the requirement for the application of detailed vehicle axle load models may be replaced with a nominal un-factored action value of 10kN/m² UDL.

4.16. 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.

4.17. All drawings submitted for approval shall have levels related to Ordnance Survey Datum Newlyn (OSDN).

4.18. 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 its serviceable life

This assessment should be completed using the National Highways computerised risk modelling system, the *Road Restraint Risk Assessment Process (RRRAP)* as implemented by CD377 where the enforced speed limit is 50mph or higher and the annual average daily traffic flow exceeds 5000 vehicles per day.

4.19. In situations outside of the scope of the above restrictions, a risk assessment generally in accordance with appendix 2 of CD377 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.

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

4.21. 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

stayingalive@lincolnshire.gov.uk

4.22. **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 **CD354**.

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's) as part of the National Highways *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's 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 or additional risk payments.

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's may exceed this information, in this instance the latter requirements shall be complied with.

Concrete

The minimum requirements for structural concrete for long term durability shall be:

Minimum strength class C32/40
Minimum cement content 325kg/m^3
Maximum aggregate size 20mm
Maximum free water cement ratio 0.45
Consistence class S2 or S3

The drawings shall state either:

- Cover for reinforcement, being nominal cover (not minimum cover), or
- Nominal Cover, fixing tolerance and minimum cover.

These values must be determined in accordance with BS 8500-1:2015+A2:2019 for an intended working life of at least 100 years.

The lowest nominal cover accepted to reinforcement shall be 40mm, including pre-cast concrete elements.

Reinforcement lap lengths must be either calculated in accordance with the Eurocode requirements or a minimum of 25d+150, multiplied by 1.4 for un-staggered tension laps, provided.

Proprietary spacer blocks shall be provided to maintain cover to reinforcement and shall be made from plastic or concrete only.

Only 1.2mm diameter stainless steel tie wire shall be used for tying reinforcement in bridge decks and exposed surfaces. In other areas

1.6 mm soft annealed iron wire may be used. All buried concrete surfaces shall receive 2 coats of an approved below ground waterproofing system.

All structural concrete shall be supplied by a Quality Assured (QA) organisation. Concrete shall be slump tested on site by the contractor for compliance prior to placing.

A minimum of 4 test cubes shall be provided by the Contractor for crushing to demonstrate compressive strength (1 x 7-day test, 2 x 28-day tests and a spare) of the concrete. An additional test may be beneficial to check early concrete strength. Care must be taken in constructing and curing the test specimens as any failure will be deemed to be indicative of the structure.

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. Sufficient anti-theft fixings shall be provided to prohibit the removal of any single parapet component.

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 and pedestrian parapets shall be painted.

Coping stones shall be mechanically fixed to the adjacent supporting structure.

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 (as BS4800):

Green	14C39
Black	00E53
Duchess Blue	20C40
Flint Grey	00A09

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

Various

Verges shall be hardened over the structure to the extents of the wing-walls or parapet, and displace water back towards the kerb. 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.

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 all 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**.

All spray applied bridge deck waterproofing systems shall receive an asphalt protective layer regardless of the necessity to provide this in the BBÁ certificate. This layer shall be a 20mm nominal thickness of sand asphalt, laid directly on the waterproofing membrane with the associated bond coat. The protective layer shall cover all areas of the waterproofing membrane. This layer shall be installed before any other operations are undertaken on the deck. Where the depth of bituminous material is greater than 100mm a red indicator mesh shall be installed directly above the bituminous additional protective layer.

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's. All other material properties remain unaltered, including the requirements for compaction. Class 6P material shall not be permitted.

All timber[*1] 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*

[*1] Note: As an alternative to timber, Fibre Reinforced Plastic (FRP) may provide a more durable and lower maintenance alternative to timber for footbridges, fencing and the like. Where appropriate, this should be provided in timber effect finish and in the colour tint necessary as part of the production process.

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 2.5 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 1:2 maximum) and hence reduce the size of headwalls required, or to construct revetments.

6.1.2. The minimum culvert diameter should be 450mm as smaller sizes are prone to blockage.

6.1.3. Regardless of any minimum hydraulic requirements, where a culvert exceeds 12m length it shall have the following minimum dimensions to facilitate access for maintenance:

- Circular culvert shall be at least 1.2 metres in diameter
- Box culvert shall have both span and height at least 1.2 metres

6.1.4. The **length of headwall / wing walls** shall be sufficient to accommodate a maximum 1:1.5 batter from watercourse bed level at the side of the culvert to verge level at the wall end.

6.1.5. Headwalls aligned perpendicular to the carriageway shall provide a minimum 2.5m verge width.

6.1.6. Vertical headwalls and wing walls shall 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.

6.1.7. The minimum cover requirements shall be provided along the entire culvert length, up to the inside faces of the headwall or revetment.

6.1.8. Distribution slabs, raft protection and the like will only be permitted above shallow pipes if justified by structural calculations demonstrating sufficient strength without imposing load on the pipes.

6.1.9. A single bore culvert is preferred to multiple pipes to reduce the risk of blockage or debris accumulating against the cutwater.

The use of multiple pipes will only be permitted when all other options are inappropriate.

The presence of multiple adjacent pipes may adversely affect the structural design of these pipes and be outside of the scope of DMRB standards.

6.1.10. 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.

6.1.11. 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.

6.1.12. In locations where the appropriate risk assessment indicates that vehicular containment is not required a pedestrian **parapet** shall 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 over the culvert (neither a metalled footway or hard surface, nor route of a public footpath) and only in remote rural areas a white painted hardwood timber or white timber effect FRP post and two rail fence may be provided to delineate the headwall location.

6.1.13. As a general rule however in urban or residential locations all drops will require protection with either a vehicular or pedestrian parapet.

6.1.14. 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 shall 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. Grills or Debris Screens

6.2.1. All culverts shall be a **straight smooth bore** without junctions, manholes, catchpits, side inlets, curved alignments or changes of direction.

6.2.2. Open and unhindered access to both ends of the culvert shall be provided.

6.2.3. Debris grills or security screens will not be permitted, unless absolutely necessary due to the potential for blockage or unauthorised access.

6.2.4. If debris grills or security screens are necessary, these shall be inclined and arrangements must be provided for safe access for cleaning the grills.

6.2.5. If required, debris grills or security screens shall be installed on both upstream and downstream ends of the culvert.

6.2.6. The provision of debris grills or security screens will **substantially increase** the commuted sum required to include the costs of regular maintenance and cleansing of the grills and the difficulties faced in inspecting such structures.

6.3. Pre-cast Concrete Box Culverts

6.3.1. All precast concrete box culverts shall be designed to the Eurocodes, usually this is undertaken by the culvert manufacturer.

6.3.2. Pre-cast concrete box culvert units shall be designed for the most onerous of the following exposure classes:

- XC3/4 and,
- Where de-icing salts may be present but with more than 1 m depth below the adjacent carriageway XD2 or,
- Where de-icing salts may be present and with less than 1 m depth below the adjacent carriageway XD3 and,
- In coastal areas XS1

6.3.3. The precast units should normally be **bedded** onto either:

- a lower bed of 150mm thickness of selected Class 6N material and an upper bed of 50mm thickness of Class 6L material; or,
- a 75mm minimum thickness blinding concrete layer of ST5 and an upper bed of 50mm thickness of Class 6L material

In hard material, the latter bedding above shall be used.

The bedding shall extend at least 300mm, or (225mm in hard material) beyond the outside faces of the structure. This minimum width may need to be increased to facilitate adequate compaction of the backfill material.

Specific consideration should be given to the bedding for the units above a headwall base slab.

6.3.4. If the **end units** are to be visible on the completed structure façade, F4 finish fair faced ends should be provided.

6.3.5. The box culvert units should be mechanically turfed together with a hydraulic culvert puller, and jointed and sealed with an approved low compressibility bitumen jointing compound, such as Tokstrip.

6.3.6. The top and sides of the units must be waterproofed with a proprietary approved bridge deck **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 in accordance with system HAPAS certificate.

6.3.7. **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.

The excavation must be sufficiently wide to allow access for the appropriate plant and machinery to compact the backfill.

This backfill material shall be laid and compacted in accordance with the SHW's and tested by the contractor to demonstrate compliance with the specification.

Care shall be exercised to ensure an **even distribution of load** to either side of the structure when backfilling.

6.3.8. 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.

6.3.9. Where it is a requirement for the interior of the box 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.

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

6.3.11. **Dry flow channels** shall not be provided in box culverts.

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

6.4.1. 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.

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

6.4.3. Minimum cover for concrete pipes shall be 0.9m. Note, cover is measured from above the top of the pipe barrel, not the pipe soffit or collars. This minimum cover shall be provided along the entire length of the pipe.

6.4.4. Junction pipes, bends or other ancillaries shall not be permitted unless these are certified by the manufacturer for the required design strength.

6.4.5. Pipes shall not be cut on site. The length of the culvert must be designed for multiples of pipe effective lengths.

6.4.6. Stub end and rocker pipes must be included at all run ends. It is imperative that stub end pipes do not have exposed reinforcement.

6.4.7. Guidance on **bedding and surround** to pipes of different sizes (up to 900mm) and strengths is given in CD533, HCD's and LCC standard drawings. The minimum bedding and backfill dimensions shall be shown on the drawings.

6.4.8. Circular concrete pipes **greater than 900mm** diameter and having depth of cover greater than 0.9m but less than 10.0m must be designed to CD533.

6.4.9. **Concrete cover slabs or raft protection shall not be permitted** over pipes as an alternative to providing a design in accordance with the above standards.

6.5.

6.6. **Plastic Pipes**

6.6.1. 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/m^2 with BBÁ certification for use as highway drainage may be provided as a permanent former for a structural concrete bed and surround.

7. Retaining Walls

7.1. The **design and construction requirements** for backfilled retaining walls as culvert headwalls are given in CD529.

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. In this case the appropriate actions from surcharge shall be agreed with Technical Services Partnership.

(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 private retaining wall outside of the public highway but located **within 3.65m** of the public highway boundary and with a **height of greater than 1.35m** will require the approval of Lincolnshire County Council as Highway Authority (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. Retaining walls must be designed using either the partial factor ('GEO') method as detailed in the Eurocodes or using a global safety factor as below.

7.7. The minimum global 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.

Load 1 – Active earth pressures
Load 2 – Traffic surcharge actions
Load 3 – Vehicular impact

Load Combination	FOS Sliding	FoS Overturning
1	2	2
1 + 2	2	2
1+ 2 +3	1.5	1.5

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

7.8. 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 (or 10% retained height, if greater) vertically of the final surface should be ignored.

7.9. 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 8002:2015 '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** and combination of actions must be applied for each condition.

7.10. The design must demonstrate resistance to **early thermal shrinkage** of immature concrete elements.

7.11. A reinforced 45º chamfer shall be provided between the retaining wall and base slab, equal to the thickness of the stem.

7.12. 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.

7.13. Where the length of wall exceeds 10 metres, consideration must be given to the provision of **joints** to accommodate shrinkage and small relative displacements due to settlement.

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

6.6.4. Concrete retaining walls shall be designed for the most onerous of the following exposure classes:

- XC3/4 and,
- Where de-icing salts may be present but with more than 1 m depth below the adjacent carriageway XD2 or,
- Where de-icing salts may be present and with less than 1 m depth below the adjacent carriageway XD3 or,
- Walls and structural supports within 10m of a carriageway XD3 and,
- In coastal areas XS1

7.15. 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.

7.16. Vandalism should be expected on concrete faces accessible to the general public, therefore measures to discourage this or protect the appearance should be provided. This may be either using a textured finish to the formwork or application of an anti-graffiti coating.

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. Load model LM4 (pedestrian loading). shall be applied to the footbridge and its constituent parts (deck, ramps, stairs, supports and foundations)

8.3. The **design criteria** for footbridges are laid out in CD353.

8.4. The footbridge must take account of the provisions of the Equality Act 2010 and allow usage by all; this may require access to be provided by both ramps and stairs.

8.5. Due consideration shall be given to vibration and dynamic response.

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

8.7. "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.

8.8. 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.

8.9. In "moderate use" situations deck boards will have anti slip grooves machined in the saw cut face the remaining three faces being planed. Anti-slip inserts are to be provided in grooved deck boards at suitable intervals. In "heavy use" situations deck boards will require a suitable epoxy resin bauxite chipping type system, or similar approved system.

8.10. Consideration shall be given to the use of fibre-reinforced plastic (FRP) and similar lightweight materials for footbridges for small spans and use of FRP components for decking and parapets on larger span footbridges.

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

8.12. Consideration shall be given to items being deliberately thrown from the footbridge onto the area below.

8.13. 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 shall 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 protection will be required.

9.3. Safety barriers and vehicle parapets are designated **vehicle restraint systems** and the requirements for these items are given in CD377.

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 CD377.

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 hydrophobic silane impregnation for durability, the plinth may be constructed using strength class C40/50 concrete.

9.8. A vehicle 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 National ‘List of EN1317 Compliant Road Restraint Systems’ document will be permitted.

9.11. Aluminium parapet systems shall not be permitted without prior approval from Technical Services Partnership due to the likelihood of theft of these systems.

9.12. Pedestrian parapets may be of steel construction with vertical infill and must comply with BS 7818.

The minimum specification for steel pedestrian parapets will be **Class 3C1**. The parapet will require a baseplate. Back-to-back posts will not be accepted.

9.13. 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.

9.14. Safety handrails to allow operative access for maintenance in areas otherwise inaccessible to the public may use tube and clamp type fittings. These tube and clamp type systems shall not be used as pedestrian parapets.

9.15. Pedestrian guardrail is not acceptable for use as a pedestrian parapet, and shall only be installed to control pedestrians, cyclists and equestrian movements within the highway.

9.16. All steel parapets shall be both **galvanised and painted** with an appropriate approved system for durability, as para 9.18 below.

Note that safety barriers and pedestrian guardrail may be galvanised only.

9.17. All metal parapets shall be provided with baseplates and fastened down into cradles cast into structural concrete. These cradles must interact with the reinforcing bars and provide the necessary concrete cover for durability.

9.18. Parapets shall receive a Type IV paint system, generally consisting of the following items:

- Pickling for hot dip galvanizing;
- Hot dip galvanize;
- 'T' Wash Adhesion promoter for hot dip galvanized steel;
- 25µm zinc phosphate epoxy (two-pack) blast primer / sealer or 125µm MIO high build quick drying epoxy (two-pack) undercoat / finish or 125µm extended cure epoxy MIO (two-pack) primer, undercoat and / or finish for hot dipped galvanized steel;
- 125µm MIO high build quick drying epoxy (two-pack) undercoat / finish or extended cure epoxy MIO (two-pack) primer, undercoat and / or finish for hot dipped galvanized steel;
- 50µm epoxy acrylic finish (two-pack) gloss or semi-gloss finish or 50µm polyurethane (two-pack) gloss or semi-gloss finish or 100µm organic modified polysiloxane (two-pack) gloss finish

The minimum total dry film thickness for zinc phosphate epoxy to be 225µm (with polysiloxane 275µm), otherwise 350µm (with polysiloxane 400µm).

1st, 2nd and 3rd coats shall be applied in the workshop; the 4th coat may be applied in the workshop or, if within the intermediate coat over-coating time, on site.

Joints and fasteners shall be protected as specified above.

10. Construction & Certification

10.1. For works undertaken under a Section 38 Agreement, key stage certification for the structure shall be endorsed and completed prior to adoption in accordance with the Development Road Specification and the terms of the Section 38 agreement.

Key stage 'X1' - Structures certificate is included in Appendix E.

10.2. The required inspection stages during construction are shown in Appendix D.

To use the table, select the structure type from the left side and cross reference the item from along the top - a letter requires action as below:

M - **Mandatory** material testing requirement to be undertaken by contractor (or NAMAS certified organisation where appropriate), with results supplied to LCC for consideration.

A - **Approval** of process or material source by LCC before commencement of activity.

N - **Notice** of activity commencement so this may be inspected by LCC on site during the operation.

I – **Inspection** of work on site following activity completion to be undertaken by LCC, but before covering by subsequent operations.

C – **Certification** by LCC on completion.

Note, several items may be inspected during a site visit, and many structural elements will require multiple inspections.

10.3. A minimum of 2 clear working days' notice will be required for any site inspections.

10.4. **Retrospective testing will not be accepted**.

10.5. Any **failure** to request an **inspection**, or give adequate **notice** of commencement of an activity, or obtain the necessary **approval**, or carry out a **mandatory** test will increase the value of the commuted sum required or incur additional risk payments to reflect the potential increased future maintenance liabilities imposed on the highway authority due to the uncertainties regarding the quality of the construction.

11. 'As Built' Drawings & Maintenance Manual

11.1. A **"Health and Safety File"** in accordance with *The Construction (Design and Management) Regulations 2015* 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.**

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

11.3. **The adoption of any structure will not be approved without the provision of an accepted Health and Safety File.**

11.4. 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.

11.5. 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.

Appendix A – Key Documents (Codes Of Practice And Design Documents)

Note: These lists are not exhaustive and do not contribute a Technical Approval schedule

Design Manual for Roads and Bridges (DMRB) documents:

Civil Engineering ("C") General Principles and Scheme Governance ("G")

CG300	Technical Approval of Highway Structures (and TAS)

Civil Engineering ("C"), Design ("D")

CD109	Highway Link Design
CD 127	Cross-sections and Headroom
CD 350	The Design of Highways Structures
CD 351	The Design and Appearance of Highways Structures
CD 353	Design criteria for footbridges
CD 354	Design of Minor Structures
CD 358	Waterproofing and surfacing of bridge decks
CD 376	Un-reinforced masonry
CD 377	Requirements for road restraint systems
CD 529	Design of outfall and culvert details
CD 533	Determination of pipe and bedding combinations for drainage works

Other documents:

Eurocodes

EN 1990	Basis of structural design
EN 1991-1-1	Actions on structures: General actions - Densities, self-weight, imposed loads for buildings
EN 1991-2	Actions on structures: Traffic loads on bridges
EN 1992-1-1	Design of concrete structures: General rules and rules for buildings
EN 1992-2	Design of concrete structures: Concrete bridges - Design and detailing
EN 1993-1-1	Design of steel structures: General rules and rules for buildings
EN 1993-2	Design of steel structures: Steel bridges
EN 1995-1-1	Design of timber structures: General - Common rules and rules for buildings
EN 1995-2	Design of timber structures: Bridges
EN 1997-1	Geotechnical design: General rules

For material specific properties
BS EN 206 Concrete
BS EN 1317 Road Restraint Systems
BS 5268 Structural Use of Timber
BS 5911 Specification for reinforced concrete pipes
BS 7818 Pedestrian restraint systems in metal
BS 8500 Concrete
BS 8666 Scheduling Reinforcement

Superseded Documents (but still of use for reference)
BD 28 Early Thermal Cracking of Concrete
BD 31 Buried concrete box type structures[*1]
BD 37 Loads for Highway Bridges[*2]
BS 5400 pt.2 Specification for loads[*2]

Other useful documents
Simplified Tables of External Loads on Buried Pipelines
CIRIA Publication C543 'Bridge Detailing Guide'
CIRIA Publication C786 'Culvert, screen and outfall manual'
HA Accepted EN1317 Compliant Road Restraint Systems
Road Restraint Risk Assessment Process (a MS Excel spread sheet)
ADEPT Bridges Commuted Sums Guidance 2017 (amended)

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)
HAT62 Safety Audits Policy and Guidance
DPD33 Traffic Management Act 2004 – Registration of Works and Road Space Booking System
Standard Drawings and Typical Details

The Manual of Contract Documents for Highway Works (MCDfHW's) documents:

Specification for Highway Works (SHW's)
Notes for Guidance on the Specification for Highway Works (NfGSHW's)
Highway Construction Details (HCD's)

[*1] – Of use for the bed and backfill details not replicated elsewhere.
[*2] – Only for use of the simplified traffic surcharge loading value(s) on rear of abutments and wing walls.

Appendix A1 – Document Web Links

DMRB, MCDfHW: https://www.standardsforhighways.co.uk/ha/standards/

CDM 2015: https://www.hse.gov.uk/construction/cdm/2015/index.htm

LCC Development Road Spec.: www.lincolnshire.gov.uk//Download/113792
Note this includes: (latest version)
- LCC inspection requirements
- Structures Design Submission Requirements
- Key Stage Certificate for structures

Road Restraints Risk Assessment Process (RRRAP):
https://www.standardsforhighways.co.uk/ha/standards/tech_info/rrrap.htm
Note: The latest version must be downloaded each time before use)

National Highways List of EN 1317 Compliant Road Restraint Systems
https://www.standardsforhighways.co.uk/ha/standards/tech_info/files/List_of_EN1317_Compliant_RRS_March_2016.pdf

ADEPT Commuted Sums Guidance
https://www.adeptnet.org.uk/documents/adept-bridges-commuted-sums-guidance-2017-amended

Standard Drawings and Typical Details - available from
http://www.lincolnshire.gov.uk/professionals/highway-works

National Highways Eurocodes strategy
http://origin.standardsforhighways.co.uk/ha/standards/tech_info/eurocodes/ha_strategy.htm

Appendix B - Technical Approval Requirements

All highway structures will require **technical approval** in accordance with CG300. 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.

CG300 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:

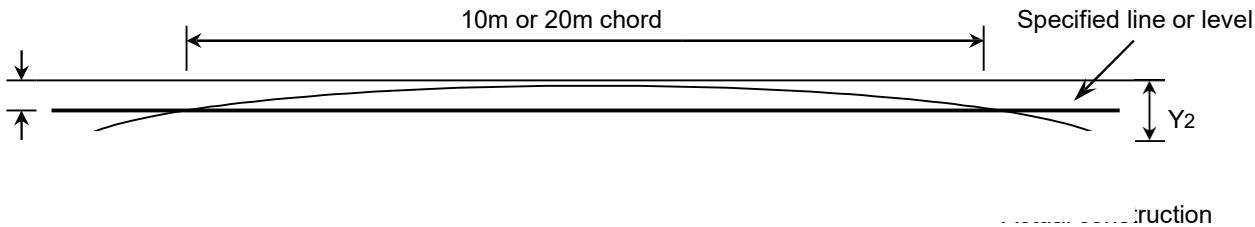
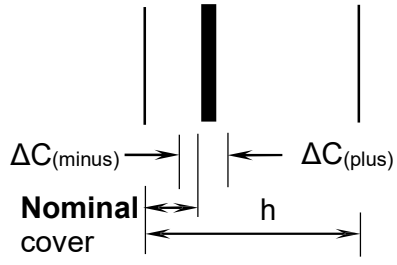


Diagram of deviation / tolerance relationship

LINE TOLERANCE	Given Line	Maximum deviation from line on			Maximum between units	Other requirements
		10m chord	20m chord	3m straight		
Walls, vertical or horizontal	± 7 mm	7 mm		7 mm	5 mm	
Soffit edges	± 7 mm		10 mm	7 mm	5 mm	
Copings	± 10 mm		5 mm		3 mm	± 7 mm over complete length being over 30m
Parapet plinths	± 10 mm		5 mm		3 mm	
Footways	± 15 mm		10 mm			Width ± 7 mm
Channels	± 15 mm		10mm			Width ± 5 mm

LEVEL TOLERANCE	Given Levels	Max. deviation from line		Maximum between units	Other requirements
		10m chord	3m straight		
Abutments, pier tops, crossheads – normal to span	± 7 mm	5 mm			
Abutments, pier tops, crossheads - parallel to span	± 7 mm				± 3 mm across width
Beam soffit	± 7 mm			5 mm	
Deck concrete	± 10 mm		10 mm		Ridge height max. ± 4 mm
Copings	± 10 mm		5 mm	2 mm	
Parapet plinths	± 10 mm		5 mm		
Channels, footways	± 10 mm		7 mm		

COVER TOLERANCE	Reinforcement Section	Section thickness / depth (h)	Permitted Deviation ΔC
All locations except foundations		≤150mm	$\Delta C_{(plus)}$ = +5mm
		400mm	$\Delta C_{(plus)}$ = +10mm
		1500mm	$\Delta C_{(plus)}$ = +15mm
		≥ 2500mm	$\Delta C_{(plus)}$ = +20mm
		All	$\Delta C_{(minus)}$ = -10mm
Foundations only	Permitted plus-deviations as above for cover to reinforcement for foundations and concrete members in foundations are increased by +15 mm. The minus-deviations given above apply.		

Appendix D – Inspection Requirements

Item / Structure	Earthworks & Backfill									Drainage							Surfacing	Structural Concrete								Pre-cast					Brickwork			Waterproofing						RRS									Completion	As-built drgs, inv. sheet & maint. manual	Pre-Adoption
	Formation	6K Lower Bedding to CSS	6N* Lower & pipe bedding	6L Upper bedding	Excavation prior to backfill	6M Surround material to CSS	6N Structural backfill material	Geotextiles	Sub-base	Drains < 600mm dia - prior to backfill	Drains < 600mm dia - following backfill	Weep holes	Pore water relief drains	Pipes >= 600mm diameter	Pitching / Facings / Revetments	Service ducts & diversions	Surfacing	Blinding	Shuttering	Reinforcement	316 Dowel bars & sleeves	Construction joints	Concrete Pours	Compressive Strengths (Cube tests)	Water stop / water bar	Installation of pre-cast box, beam, units	Installation of pipes > 600mm dia	Manhole / catchpit chambers	Filling of clutches / lifting eyes	Jointing material	316 Fixings, channels etc.	Brickwork / Blockwork	Stone copings	Spray applied waterproofing	Pin hole 'Holiday' testing	Sheet applied waterproofing	Expansion joints	Movement joints	Other Below ground waterproofing	Steel Parapets (Veh/Ped)	Brick Parapets	Safety barriers	Timber Fences	Trial Erection	Final Erection	Preparation for protective systems	Completion of protective systems	**Completion**	As-built drgs, inv. sheet & maint. manual	**Pre-Adoption**
Box Culverts																																															**C**	**I**	**C**
Precast units	I		I	I	I		A		N				I	N		A	I				I				N	N		I	I				N	M	I	N		I										
Headwalls	I				I		A	I	N			I	I	N	I	A		I	I	I	I	I	N	M	I		N	I			I	I	I			I	I	I	I	I	I				I			
Retaining Walls																																															**C**	**I**	**C**
Brick / block elements	I				I		A		N			I	I		I	A						N												A	I	I	I	I	I	I				I			
In-situ concrete	I				I		A		N			I	I		I	A		I	I	I	I	I	N	M	I									A	I	I	I	I	I	I				I			
Reinforced earth	I				I		A	N	N			I	I		I	A																			I		I	I	I	I				I			
Culverts & Drainage																																														**C**	**I**	**C**
Concrete pipes	I		A		I		A	I		I	I				I	A	I									N	I								I												
Plastic pipes	I		A		I		A	I		I	I			N	I	A	I					N	M				I									I												
Headwalls	I				I		A	I	N			I	I	N	I	A		I	I	I	I	I	N	M	I						I	I	I				I	I	I	I	I	I				I			
Footbridges																																															**C**	**I**	**C**
Abutments	I				I		A	I	N			I	I		I	A		I	I	I	I	I	N	M	I						I	I	I				I	I										
Deck / Superstructure																A	I									N			I				N	M		I		I		I			I	M	N	I	I			
Bridges																																															**C**	**I**	**C**
Foundations	I				I		A	I										I	I	I		I	N	M	I											I												
Abutments	I				I		A	I	N			I	I		I	A	I	I	I	I	I	I	N	M	I						I			N		I	A	I	I									
Deck																A	N		I	I		I	N	M		N			I				N	M	I	N		I				M	N	I	I			
Parapets																			I	I		I	N	M		N					I	I	I				I		I	I	I	I		I	A	I			
VRS																																															**C**	**I**	**C**
Safety Barriers	M															A						N	M																I							I			
Terminals	I															A						N	M																I							I			

Appendix E - Key Stage Certificate

DEVELOPMENT ROAD CONSTRUCTION STAGE CERTIFICATE

KEY STAGE X1 – STRUCTURES

In accordance with the Section 38 Agreement for the development known as:-

General Information	
Developers Name	
Phase	
Site location	

are required to obtain from the County Council, as Highway Authority, certification that the **Highway Structures** works on this development have been carried out in accordance with the specification and agreed drawings and inspected and tested by an authorised representative of the County Council at the correct time.

The requirements for inspection, notice, testing, approval and certification for different types of Highway Structure are defined on the "*INSPECTION REQUIREMENTS FOR STRUCTURAL WORKS*" sheet. For all other structures, the requirements must be agreed with LCC representatives in advance of commencement of the works.

In order to meet the above requirements, the nominated person named in accordance with the Section 38 Agreement as being responsible for managing construction and quality for the developer, in addition to ensuring compliance with this specification, shall notify in good time **(a minimum of two clear working days' notice)** and provide facility for the authorised representative of the County Council to carry out the required inspections, tests and the like detailed below:-

Key to requirements:

'M' - Mandatory testing to be undertaken by contractor, with the results passed to LCC for approval. Some testing may be required to be witnessed by LCC representatives on site, as noted below.

'A' – Prior approval of process / material source by LCC, before commencement of associated operation.

'N' - Notice to LCC of activity commencement is required, to allow LCC representatives the opportunity to be present on site during these operations to witness, inspect and test during the execution of the specified operations.

'I' - Inspection of works on activity completion. Several items shall be expected to be inspected during a site visit. For concrete pours, this will be in the form of a pre-pour inspection by LCC representatives.

Sufficient time must be allowed for the rectification of any defects discovered during inspection before the commencement of subsequent operations, notably the delivery of fresh concrete.

'C' - Certification on successful completion of all required structural works.

Lincolnshire COUNTY COUNCIL
Working for a better future

Inspection, Test, Notification, Approval and Certification Stages

Item			Frequency / Inspection Timing	Completed[*3]	
				By	Date
Earthworks & Backfill	Formation	I	All areas[*1]		
	Lower & pipe bedding	A	All sources		
	Upper bedding	I	All areas		
	Excavation prior to backfill	I	All areas		
	Structural backfill material	A	All sources		
	Geotextiles	I,N	All areas		
	Sub-base	N	All areas – as *Key Stage T3*		
Drainage	Drains < 600mm dia - prior to backfill	I	All areas – as *Key Stage T1*		
	Drains < 600mm dia - following backfill	I	All areas – as *Key Stage T1*		
	Weep Holes	I	All, prior to any backfilling		
	Pore water relief drains	I	All, prior to any backfilling		
	Pipes >= 600mm diameter	N	All lengths		
	Pitching / Facings / Revetments	I	All		
	Service ducts & diversions	A	Before commencement		
Surfacing		I,N	All areas – as *Key Stage T8*		
Structural Concrete	Blinding	I	All areas		
	Shuttering	I	All, as pre-pour inspection		
	Reinforcement	I	All, as pre-pour inspection		
	Dowel bars & sleeves	I	All, as pre-pour inspection		
	Construction joints	I	All, as pre-pour inspection		
	Concrete Pours	N	All, to be witnessed by LCC		
	Compressive Strengths (Cube tests)	M	3x28 day cubes, each pour/15t		
	Water stop / water bar	I	All, as pre-pour inspection		
Pre-cast	Installation of pre-cast box, beam, units	N	All, to be witnessed by LCC		
	Installation of pipes > 600mm dia	N	All lengths, before backfill		
	Manhole / catch-pit chambers	I	All		
	Filling of clutches / lifting eyes	I	All		
	Jointing material	I	All		
Brick work	Fixings, channels etc.	I	All		
	Brickwork / Blockwork	I	All		
	Stone copings	I	All		
Water-proofing	Spray applied waterproofing	N	To be witnessed by LCC Rep.		
	Pin hole 'Holiday' testing	M	To be witnessed by LCC Rep.		
	Sheet applied waterproofing	I	All		
	Expansion joints	A,N	All		
	Movement joints	I	All		
	Other Below ground waterproofing	I	All		
RRS	Steel Parapets (Veh/Ped)	I	All		
	Brick Parapets	I	All		
	Safety barriers	I	All		
	Timber Fences	I	All		
Steel work	Trial Erection	M	All		
	Final Erection	I,N	To be witnessed by LCC Rep.		
	Preparation for protective systems	A,I	All, req. to be confirmed		
	Completion of protective systems	I	All, req. to be confirmed		
Completion		C	All structures		
As-built drgs, inv. sheet & maint. manual		I	Info to be supplied for review		
Pre-Adoption		C	All structures		

Mandatory testing to be undertaken **by the Contractor**	Frequency	Results passed by LCC Authorised Representative
Compaction of 6N material in backfill to structures	All areas, minimum daily or 1 test every 100t of material	
Fresh concrete - workability	Every delivery – All loads outside of specification tolerances shall be rejected. No additional water shall be added to concrete on site	
Fresh concrete - strength	3 test cubes to be taken every 15t (each delivery) or part thereof. To be tested at age 28 days only[*2]. Care to be taken in correctly curing the test cubes.	
Concrete (in-situ only) – cover to reinforcement	Cover measurement survey of all reinforced concrete surfaces, on a 500 mm grid over the whole structure.	
Spray applied waterproofing material - bond	2 tests minimum daily, per 100m^2 of waterproofing area.	
Spray applied waterproofing material – pinhole tests	Entire waterproofing membrane, and all defects after repair	
Trial erection of steelwork	For all structures	

[*1] – In-situ ground testing may be required to corroborate design values with the exposed formation material

[*2] – Additional cubes tests at earlier age may be required to demonstrate sufficient early structural strength for subsequent operations or use by traffic

[*3] – To be endorsed by LCC Authorised Representative once all operations are satisfactorily completed

Should the named representative of the developer fail to notify, inform or allow facility for the authorised representative of the County Council to carry out the above Inspections, Tests and the like at the correct time, the County Council may refuse to sanction adoption of the structure and any associated carriageway, footway etc. dependent on the structure for access.

Generally, retrospective testing will not be sufficient to demonstrate the suitability of a structure for adoption.

Payment by the Developer for Failure to Achieve Certification of the Key Stage of STRUCTURES

In addition and irrespective of any retrospective testing or the outcome of such tests, should the Developer fail to obtain the relevant certificate for the key stage of STRUCTURES on this development or proceed without the consent of the Executive Director for Development Services (or persons authorised by him), then the Council will require the Developer to pay a sum to the Council to cover possible future risk to the Authority associated with the lack of inspection and/or testing at the correct stage.

Any deficiency or failure potentially affecting public safety will require rectification prior to adoption. Any deficiency or failure affecting the potential durability of the structure may be subject to an additional risk payment.

This additional risk payment will generally be calculated as a substantial reduction in the "time to replacement" in, and/or additional maintenance operations added into the, commuted sum calculation as determined by LCC representatives.

The alternative course of action to the above is for the Developer to remove all works and materials down to the lowest stage of construction which has an approval certificate to allow the specified inspections and testing to take place in accordance with the Section 38 Agreement.

CERTIFICATION OF DEVELOPMENT ROAD
KEY CONSTRUCTION STAGE

KEY STAGE X1 - STRUCTURES

This is to certify that the key construction stage of STRUCTURES has been satisfactorily notified and completed by:-

General Information	
Developers Name	
Phase	
Site location	

Development and that the key inspections and the key tests, above, have been successfully completed.

Signed

Authorised representative of the County Council on behalf of the Executive Director for Place

Date

Counter Signed

Lincolnshire County Council Technical Manager

Date

Notwithstanding the above, the responsibility for all works and supervision on Development Roads lies with the developer. It is totally his responsibility to ensure and achieve compliance with the specification. Inspections and testing carried out by Lincolnshire County Council and this certification do not absolve the developer from this responsibility in any way.

Lincolnshire COUNTY COUNCIL
Working for a better future

Appendix F - Checklist

EXTERNALLY PROMOTED HIGHWAY STRUCTURES			
Application "Duly Made" Check - Submission Documents			
Item	Item Description (see associated guidance notes)	Included	Not required
1	General arrangement drawing		
2	Location plan		
3	Detailed construction drawings		
4	Reinforcement drawings		
	Reinforcement schedules		
5	Land plans		
6	Design certificate		
	Check certificate		
	Approval in Principle document, including TAS		
7	Specification requirements		
8	Designed concrete mix		
9	Detailed design calculations		
	Design calculations indicated as checked		
10	Assessment of need to provide a vehicle restraint system		
11	Departure from standards submission		
12	Proof of Flood Defence Consent (EA/IDB)		
	Proof of approvals from others		
13	Ground investigation report		
14	Details of provision for buried services		
15	Temporary works proposals		
Is structure to be offered for adoption?		YES / NO	
Check by:		Date:	

Externally Promoted Highway Structures - Document Guidance notes:	
1	General arrangement drawing (a separate drawing is required for each structure), including plan, cross section, long section and elevations.
2	Location plan, showing detailed method of maintaining access to properties for the future replacement of structure.
3	Detailed construction drawings, showing detailed dimensions and levels of all structural elements (sufficient for our inspector to adequately check the construction on site), and include – earthworks details, bed and backfill, formwork finishes, waterproofing (inc. protective layer), concrete specifications, brickwork and copings, movement joints and sealants, surfacing, impermeable verges, parapet details (including protective paint system), drainage. Final earthworks proposals around headwalls should be shown to demonstrate the bank slopes do not exceed 1:1.5.
4	Reinforcement drawings and schedules (must be checked), cover must be specified on the drawings (minimum 50mm). The minimum expected reinforcement will be 16mm Ø bars at 150mm ctrs.
5	Land plans; showing structure to be wholly located within the adopted highway, and 3m minimum maintenance easement provided from all extents of the structure.
6	Design and check certificates, and where appropriate an Approval in Principle document (for CAT1, 2, 3 structures) including TAS – in accordance with GC300.
7	Specification requirements and any amendments to the specification. The drawings should note: - • LCC minimum structural concrete mix for durability: Strength C32/40, min. cement content 325kg/m³, max. W/C ratio 0.45, max. agg. size 20mm.· • All buried structural concrete must be protected with 2 coats of a suitable below ground waterproofing material. • 6N material to be graded as type 1 sub-base (all other characteristics remain, including the requirement for Contractor testing to demonstrate compaction to 95% density at OMC)· • Bricks must have a strength of greater than 75 N/mm² and water absorption of less than 7% (equivalent to class B engineering), laid in class 3 mortar.
8	Designed concrete mix minimum constituents for structural concrete in accordance with BS8500, and demonstrating a durability of 100 years for the appropriate exposure classification (RC40 is not acceptable).
9	Detailed design calculations (strictly, and only, in accordance with relevant D.M.R.B. standards or UK Bridges parts of Eurocodes) for all structural elements, including box culverts, headwalls, buried pipes, distribution slabs, retaining walls etc. • The calculations must be sufficiently annotated and must be checked (note an independent check may be necessary if required by GC300). • Characteristic values of ground strength parameters determined by the Ground Investigation must be used for the geotechnical design, and in the absence of a GI only very conservative values will be accepted. • To include calculations demonstrating the design stability, adequacy of sections and reinforcement (in bending and shear), durability (crack widths) and early thermal cracking. • All areas and elements of the structure must be shown to be adversely affected by the action of vehicle loading ("Pedestrian loading" is only for footbridges). • The calculations must result in unambiguous conclusions and the design shown on the detailed construction and reinforcement drawings must equal or exceed these conclusions.
10	Assessment of need to provide a vehicle restraint system in accordance with CD377 or LCC standard ("***PVRSAS***") as appropriate. See HAT 51
11	Departure from standards submission for endorsement (required for the omission of safety barriers from ends of vehicle parapets).
12	Proof of approvals necessary from others (notably ***Flood Defence Consent*** from the appropriate drainage authorities, indicating agreement to proposed waterway areas and invert levels).
13	Ground investigation report, including confirmation of values used for allowable bearing pressures for foundations in any structural analysis.
14	Details of provision for both current and future buried services to pass over the structure without undue disturbance (many spare ducts).
15	Any temporary works proposals, working methods or restrictions and an assessment of their effects this or any other affected structure.