

Guidance Document

G0051

Civil Engineering – Bridge Structures

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1 Purpose

1.1 The purpose of this Manual of Good Practice is to support LU Standard S1051 (Civil Engineering – Bridge Structures) and provides guidance on established good practice solutions that meet the requirements of that standard. The Bridge Structure assets comprise:

- a) **Rail bridges.** This category of structure covers structures owned by LU carrying LU tracks, including:
 - I) Underbridge;
 - II) Overbridge;
 - III) Viaduct;
 - IV) Girdering;
 - V) Way beams.
- b) **Highway bridges.** This category of structure covers structures owned by LU carrying public or private road traffic, including:
 - I) Overbridge;
 - II) Viaduct.
- c) **Footbridges;**
- d) **Underground structures.** This category of structure covers:
 - I) Covered ways;
 - II) Subsurface tunnels (i.e. cut and cover tunnel);
 - III) Subways;
 - IV) Culverts.
- e) **Earth retaining walls, including gabions;**
- f) **Ancillary structures and components.** This category of structure covers:
 - I) Cable bridges;
 - II) Pipe bridges;
 - III) Pipe crossings over / under track;
 - IV) Signal gantries;
 - V) Gantries over railway;
 - VI) Crash barriers;
 - VII) Longitudinal timbers.

2 Scope

2.1 This document is to provide guidance on the application of the requirements for the Bridge Structure assets owned by LU through the life cycle stages:

- a) Inception and design;
- b) Construction, installation, testing and commissioning;
- c) Inspection;
- d) Analytical assessment;
- e) Condition assessment and certification;
- f) Maintenance;
- g) Strengthening and renewal;
- h) Decommissioning.



- 2.2 This Manual mirrors the sub-section headings of LU Standard S1051 (Civil Engineering – Bridge Structures) at the start of each life cycle section, but additionally has further sub-sections added to each life-cycle section where there is further guidance material available to LU that does not specifically relate to the sub-section headings used in the standard, or is better set out separately.
- 2.3 The information contained in this Manual is derived mainly from historical information contained in existing LU documents and therefore does not necessarily reflect current good practice. Where possible, existing historical information has been supplemented by references to current good industry practice.
- 2.4 This Manual replaces G-051 A4

3 Guidance

3.1 Inception and design

3.1.1 General

The Required Duty for Bridge Structures is reconsidered annually and published in the Bridges and Structures Foundation Document.

3.1.2 Inception

The inception and subsequent design processes for Bridge Structure assets are set out in LU Standard E1008 (New or Altered Assets – Approvals Prior to Bringing Into Use).

3.1.3 Design process

- 3.1.3.1 Design concessions are required to cover any non-compliance of the submitted design with LU Standards and requirements. These design concessions are requested by the design organisation in accordance with 1-641 (Concessions to Category 1, Mixed Category and Category 5 Standards) and the need to be formally approved by LU before becoming part of the design.

- 3.1.3.2 Prior to starting detailed design for new construction or renewal, the appointed design organisation is required to create a Conceptual Design Statement (CDS). Detailed guidance on the creation of CDS is given in LU Manual of Good Practice G-050 (Civil Engineering – Common Requirements).

3.1.4 Structure gauge and clearance

No specific advice.

3.1.5 Ground investigation information

Refer to LU Manual of Good Practice G-050 (Civil Engineering – Common Requirements) for guidance.

3.1.6 Groundwater

No specific advice.



3.1.7 Design life

No specific advice.

3.1.8 Fire resistance

No specific advice.

3.1.9 Constructability

The UK highways bridge stock is exhibiting durability problems. While there are several causes of deterioration, many of the problems are attributed to poor detailing and a lack of appreciation of constructability or buildability by designers. There are many sources of advice on bridge detailing but the advice is rarely collected together. Most available professional information comes as advice incidental to particular projects or subjects. CIRIA Report C543 "Bridge Detailing Guide" gives guidance for engineers and technicians engaged in the preparation and development of details for highway and accommodation bridges, subways, culverts and retaining walls. The guide concentrates on the detailing issues that follow conceptual and analytical design. It also covers some design issues, such as access during and after construction and CDM requirements, due to their direct relevance to the detailing stage. The guide explores basic principles that have proved to be reliable in everyday use, in terms of durability and ease of construction, inspection, maintenance and repair. The guide is intended as a live document and will be revised and extended as a result of feedback by the industry. A formal feedback procedure is, therefore, included. A CD-ROM is also provided with the report. This holds the 'details' in CAD format. This guide is useful for consultants, contractors, bridge owners and their maintaining agents.

3.1.10 Impact on operational railway and adjacent structures

Refer to LU Manual of Good Practice G-050 (Civil Engineering – Common Requirements) for guidance.

3.1.11 Co-ordination with Outside Parties

No specific advice.

3.1.12 Services

No specific advice.

3.1.13 Drainage

Refer to LU Manual of Good Practice G-052 (Civil Engineering – Gravity Drainage Systems) for guidance.

3.1.14 Parapets and handrails

3.1.14.1 Rail bridges

No specific advice.

3.1.14.2 Highway bridges

The HA documents 'Interim Requirements for Road Restraint Systems (IRRRS) and Interim Advice Note 44/05 should be followed in the design of road restraint systems.

3.1.14.3 Footbridges

No specific advice.



3.1.14.4 Underground structures, earth retaining walls and ancillary structures

Guidance on the design of embedded retaining walls is given in CIRIA Report C580.

3.1.15 Structural design

3.1.15.1 General

Best practice guidance on integral bridge design and construction is given by the Steel Construction Institute (SCI) and the Concrete Bridge Development Group (CBDG). It is likely that consideration of the difficulties of future deck maintenance and replacement may preclude the use of this type of construction on the operational railway.

3.1.15.2 Concrete, steel and composite structures

- a) Guidance on best practice on steel railway bridge design should be sought from the SCI publication 'Design Guide for Steel Railway Bridges'. This publication also gives guidance on assessment and construction best practice;
- b) Guidance on best practice for composite highway bridge design should be sought from the 2001 edition of the SCI publication 'Design Guide for Composite Highway Bridges: General Guidance';
- c) CBDG publication Current Practice Sheet No. 1 gives guidance on footbridge design.

3.1.15.3 Underground structures and earth retaining walls

The specification of gabion walls should require that:

- a) vertical joints should give an attractive appearance and avoid the creation of weak vertical joints;
- b) the tolerance of the gabion wall line should be $\pm 50\text{mm}$ with no undue distortion in individual units;
- c) gabions should be initially overfilled sufficiently to accommodate subsequent settlement and to ensure full shear resistance between successive courses;
- d) gabion tops should be tensioned and securely tied down;
- e) adjacent gabion should be fastened together in accordance with the manufacturer's installation instructions, using binding wire having the same durability as the gabion boxes;
- f) gabions should be filled in place unless special provisions are made to prevent overstress and distortion of the boxes during lifting so as to allow pre-filling elsewhere followed by lifting into place.

3.1.15.4 Longitudinal timbers

On the LU system, longitudinal timbers are often spanning load bearing members. Account must be taken of this function and the timbers checked for their ability to carry RL or RU loading as appropriate. LU standards give directions on γ factors and design standards. It is also essential that the timbers are in contact with the bridge structure at all times so that dynamic impact factors are kept to a minimum. Restraint systems should be installed to ensure this, even where timbers are not spanning load carrying members.

The timber steel interface is always an area prone to corrosion, and an insulating membrane or sacrificial layer should be placed under the timber, where it is in contact with the bridge structure.



If longitudinal timbers extend onto or past ballast walls, the ballast walls should be checked for their resistance to load effects, and strengthened where found to be insufficient.

3.1.15.5 Ancillary structures and components

No specific advice.

3.1.15.6 Foundations

No specific advice.

3.1.15.7 Bearings and expansion joints

No specific advice.

3.1.16 Loading

3.1.16.1 General

No specific advice.

3.1.16.2 Permanent loadings

No specific advice.

3.1.16.3 Live loading

a) Rail bridges;

No specific advice.

b) Highway bridges;

No specific advice.

c) Footbridge loading;

No specific advice.

d) Underground structures and earth retaining walls;

No specific advice.

e) Ancillary structures and components.

No specific advice.

3.1.16.4 Pressure effects of railway traffic

No specific advice.

3.1.16.5 Wind loading

No specific advice.

3.1.16.6 Loading of foundations, underground structures and earth retaining walls

No specific advice.

3.1.16.7 Loading during construction

No specific advice.

3.1.17 Partial load factors and load combinations

3.1.17.1 Rail bridges

No specific advice.

3.1.17.2 Highway bridges

No specific advice.

3.1.17.3 Footbridges

No specific advice.



3.1.17.4 Underground structures and earth retaining walls

No specific advice.

3.1.17.5 Ancillary structures and components

No specific advice.

3.1.18 Durability

3.1.18.1 The achievement of durability in a structure requires appropriate selection of environmental exposure, suitable design and detailing, and an appropriate specification to be followed by the supply of materials to the specification and good site workmanship. The concept of durability design should be embraced and for concrete design reference should be made to Concrete Society Report CS109.

Waterproofing - Overline bridges, girderings and covered ways

- a) These should be designed to be waterproofed in accordance with Department of Transport (DoT) Technical Memorandum (Bridges) BE 27, with the following exceptions:
 - I) a protective layer should always be applied irrespective of waterproofing thickness;
 - II) The protective layer to be applied to the waterproofing of overline bridges, girderings and covered ways should be red GRC tiles 300mm square and 15mm thick with the LUL logo embossed into the upper surface. The tiles should be set in an adhesive layer compatible with the waterproofing.

Waterproofing - Underline bridges

- b) The repair of failed or damaged underline bridge deck waterproofing is more expensive and difficult than the repair of waterproofing to overline structures due to the necessity of lifting tracks and ballast during short possessions. Thus small savings on the initial cost of waterproofing will not be justified if maintenance problems are created or the materials prove to have a short life;
- c) If the waterproofing is to be successful and have a long life, proper surface preparation of the bridge deck and a high standard of workmanship in laying the waterproofing and subsequent protective layers and surfacing are essential. Protective layers must be laid as soon as possible after waterproofing. The contractor should take all necessary precautions to prevent damage to the waterproofing. Plant and materials should not be placed upon it and the contractors' staff should walk on it only when absolutely essential. Particular care should be taken to ensure that suitable footwear is worn whilst the membrane is being laid and whilst the permanent protection is being placed. Waterproofing must not be laid at ambient temperatures below 4°C. All proprietary materials should be laid strictly in accordance with the manufacturers recommendations;
- d) Surface finish should be as follows. Immediately after placing the concrete, the surface should be struck off with a screed board to produce a plain or ridged surface. After the concrete has hardened sufficiently, the concrete should be floated by hand or machine sufficiently only to produce a plain surface, free from screed board marks. In addition it should be:
 - I) finished to an accuracy such that when tested with a 3 m straight edge the maximum depression does not exceed 10 mm;
 - II) clean and dry;
 - III) free from membrane curing compound and projecting tying wire;



- IV) free from abrupt irregularities exceeding 3 mm.
- e) If curing membranes are used, at least 28 days should be allowed to elapse between applying the curing membrane and laying the waterproofing. If shown to be necessary this period should be extended or the surface brushed to ensure the removal of any remaining compound;
- f) Materials must be reasonably tolerant of adverse conditions, they must be impervious to water and meet the following requirements:
- I) When tested in accordance with DoT Technical Memorandum (Bridges) BE 27 Appendix A should not fracture beyond the lower limit defined in Clause A3i or ii of that document when the concrete test piece attains a crack width appropriate to the stress condition of the surface to be waterproofed, i.e. 0.25 mm where no tensile stress occurs and 0.6 mm otherwise;
 - II) Have satisfactory resistance to damage during site operations including the laying of the protective layer;
 - III) Not be susceptible to damage at a temperature of 140°C (or 200°C if hot adhesives are used). Prefabricated materials should not be unduly stiff or liable to crack when laid at temperatures down to 4°C.
- g) If it is decided to be necessary to prime the concrete deck, the primer must be compatible with any adhesive and waterproofing which is to be laid on it. Primers must be evenly spread by brushing and not allowed to concentrate in depressions;
- h) As soon as possible after applying the waterproof membrane it should be permanently protected by an approved boarded system or a concrete screed of grade 25 concrete 100 mm thick, reinforced with mesh ref. A142 to BS 4483;
- j) The deck plates or troughing should be blast cleaned and a protective coating applied;
- k) Decks with longitudinal timbers should require no more waterproofing nor protection than specified above, but note the requirement of clause 3.1.15.4
- m) For decks carrying ballasted tracks, the deck surface, which must be clean and dry (after washing with detergent if necessary), should be given an even coat of an approved bituminous adhesive at a rate of 0.22 to 0.13 l/m² immediately before the waterproofing;
- n) The waterproofing should be a rubberised filled bitumen made from 80 - 100 pen. straight run bitumen, limestone filler with grading and qualifier in accordance with the filler specification given in BS 594, and unvulcanised rubber powder. The final softening point (ring and ball) of the mixture should be between 90°C and 100°C;

Waterproofing - Bridge abutments

- o) All bridge abutments should be waterproofed on their 'soil face' and should be backed by a free draining medium. This free draining medium should be drained to a soakaway positioned so as not to affect any soil structure or track formation;
- p) The abutment should be waterproofed to attain Grade 2 level of protection as specified in Table 1 of BS 8102, Appendix A;

Waterproofing - Footbridges and platforms - Non Section 12 Stations

- q) Footbridges and platforms are perceived to be less important structures than those subject to dynamic loading. However they require proper and adequate waterproofing to attain their full economic life and to retain their structural integrity;



- r) The requirements for waterproofing of concrete and steel overline bridges, girderings and covered ways should apply to Footbridges and platforms except that the protective layer or wearing course should be as specified in LU Standard 1-135 (Premises – Finishes);
- s) It is essential that timber decking is allowed to be free draining to prevent the retention of moisture which will lead to rot. Thus a waterproof membrane should not be applied but the timber should be properly seasoned and impregnated. The timber should be laid so that free draining is assured;
- t) Particular care must be taken in the design of non-slip sheet type surfaces to be applied to existing timber decks. These should be fixed to battens to allow free movement of air between the structural timbers and the wearing surface;
- u) Where timbers are fixed to steelwork, corrosion of the steelwork is a long-term problem. To reduce this corrosion problem, the steelwork should be suitably protected and an impervious membrane placed between the steel and timber;

Waterproofing – Footbridges and platforms – Section 12 Stations

- w) These stations are by definition within a waterproof enclosure and therefore Footbridges and platforms within their confines will not require waterproofing;

Waterproofing – Sub-surface structures

- x) The waterproofing of sub-surface structures is of major importance since any fault in workmanship or failure during the life of the structure can result in leakage and spoiling of finishes. Remedial waterproofing measures to these structures are very extensive and rarely totally effective. For this reason effective waterproofing at the time of construction is essential;
- y) All new construction should be designed and constructed to attain a performance level of Grade 3 as specified in table 1 of BS 8102;
- z) The construction should be in concrete designed in accordance with BS 8007 with an external vapour proof membrane. Water-bars should be used in all construction joints;
- aa) The requirements for workmanship in applying waterproofing to sub-surface structures should be as laid down in BS 8000: Part 4;

Waterproofing – New and existing waterproofing junctions

- ab) The junction between new and existing waterproofing is a potential source of leakage. The following precautions should be taken:
 - I) New work should be taken to a point which will provide a strong waterproof joint, e.g. the finished structure levels must be the same to prevent a 'well' or 'dam' forming;
 - II) The new and existing waterproofing must be compatible. If the new waterproofing is a repair then spray applied membranes are recommended;
 - III) The junction of new and existing waterproofing should be tested by damming the junction and filling with water to a depth of 150 mm. The junction should show no visible seepage after a period of 24 hours from filling the dam.

Waterproofing – Materials

- ac) Materials used for waterproofing should meet the requirements of the relevant British Standard (or equivalent European Standard), or hold an Agrément certificate.



Waterproofing – Work on site

- ad) A method statement for work on site should be prepared;
- ae) Hot process on site should be avoided if possible. No hot processes should be permitted on Section 12 Station sites unless a hot process licence has been obtained.

3.1.19 Provision for maintenance

The design should generally involve minimum maintenance during the Design Life. Future maintenance should be borne in mind during detailed design.

3.1.20 Temporary works

Temporary Works play an important role in the planning and construction of Bridge Structure maintenance and renewal works. The Temporary Works requirements should be considered at design stage.

3.1.21 Design documents

No specific advice.

3.1.22 Construction documents

No specific advice.

3.2 Construction, installation, testing and commissioning

3.2.1 General

- 3.2.1.1 When undertaking new construction, renewal or maintenance works all necessary measures should be undertaken to ensure that the work does not detrimentally affect the railway and adjacent structures or services.
- 3.2.1.2 The asset engineer should be informed of any work which may affect other engineering assets and detailed method statements should be prepared and approved by suitably experienced persons, fully detailing the protection measures to be implemented. Utility companies should also be advised of any work undertaken adjacent to their services.
- 3.2.1.3 The provision for unobstructed movement at the cess is a clear safety requirement for works to be carried out while trains are running.
- 3.2.1.4 When working adjacent to the LU cable posts which carry signals, compressed air and high voltage cables, the relevant parties within LU should be informed in advance of the proposed works commencing. Prior to any work, an inspection of the existing cable condition should be undertaken. When work is undertaken adjacent to high voltage cables reference should be made to LU Standard 1-114 (Safe Systems of work on or near electrical equipment)
- 3.2.1.5 Ideally arrangements should be made to have the lineside services cables removed from the cable post supports into cable troughs over vulnerable areas for the duration of the works on site. This precautionary measure will ensure that the potential risks to the cables from construction activity adjacent to the track are reduced to a minimum during the construction phase of the works. When undertaking new construction, renewal or maintenance work all necessary measures should be taken to ensure that the work does not detrimentally affect the railway and adjacent structures or services.



3.2.2 Work site and access

3.2.2.1 Control of noise

The Supplier should ensure that, wherever practical, noise from the works and ancillary activities is not audible at the site boundary other than between the hours of 8 am and 6 pm on Monday to Friday and 8 am to 1 pm on Saturday. Any special measures, agreed with the local authorities to mitigate construction noise at night may be included in the environmental statement.

3.2.2.2 Prior to commencement of works at any site, the Supplier should prepare:

- a) a method statement (in accordance with the principles described in BS 5228), stating precisely the type of plant to be used and the proposed noise control methods;
- b) a programme of work indicating the sound level and location for each activity on the programme;
- c) documentation from manufacturers' literature establishing the sound power level of plant;
- d) calculations of L_{aeq} – the continuous A-weighted sound pressure level (in dB) determined at a distance of 10m from and during the period of a given activity, and maximum sound levels at specified buildings.

3.2.2.3 Before the commencement of the works the Supplier should initiate background baseline noise surveys in order to formally establish noise levels for each specific site.

3.2.2.4 In assessing the impact of any piling operations, the Supplier should comply with the recommendations set out in BS 5228: Parts 1 and 4.

3.2.2.5 Local authorities should be given access to all noise readings, if required, as soon as they become available.

3.2.2.5 Vehicles and mechanical plant used for the purpose of the works should be fitted with effective exhaust silencers and should be maintained in good and efficient working order and operated in such a manner as to minimise noise emissions.

3.2.2.6 On surface sites:

- a) compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use;
- b) pneumatic percussive tools should be fitted with an effective muffler or silencer suitable for use with each particular item of plant.
- c) Plant and equipment liable to create noise whilst in operation should be sited as far away as is practicable from noise sensitive locations. The use of barriers, e.g. soil mounds, site huts, acoustic sheds or partitions to deflect noise away from noise sensitive areas should be employed wherever practicable.

3.2.2.7 Care should be taken when loading or unloading vehicles, dismantling scaffolding or moving materials and equipment to reduce impact noise.

3.2.2.8 Vibration

Measures should be taken to protect the residents and users of buildings in the vicinity of the works and passers-by from nuisance or harm from vibrations and protect buildings from physical damage.



3.2.2.9 Air Pollution

All necessary precautions should be taken to prevent the occurrence of smoke emissions or fumes from site plant or stored fuel oils for safety reasons and to prevent such emissions or fumes drifting into residential areas. In particular, plant is to be well maintained and measures taken to ensure that it is not left running for long periods when not directly in use.

3.2.2.10 The burning of any material on the site should not be permitted.

3.2.2.11 Dust

All necessary measures should be taken to avoid creating a dust nuisance. A statement identifying proposed measures for the limitation of dust should be prepared prior to the commencement of work.

3.2.2.12 The effectiveness of the measures should be monitored frequently.

3.2.2.13 The Local authorities concerned should be informed of the measures being taken to conform with the above.

3.2.2.14 Equipment

Attention is drawn to the presence within the area of the Works of cables, lighting, signalling apparatus, machinery and other railway equipment which must be maintained in operation during the course of the works. Adequate access and space for inspection and maintenance of such equipment should be allowed.

3.2.2.15 Sightlines

Where sightlines access points are sub-standard (or where vehicles will be required to move in reverse), vehicles entering or leaving the site should only be allowed to cross footways under the control of a competent person.

3.2.3 Construction methods

No specific advice.

3.2.4 Materials

No specific advice.

3.2.5 Instrumentation and monitoring

No specific advice.

3.2.6 Concrete construction

Reference should be made to the following CIRIA reports:

- a) CIRIA Report C511 – Controlled permeability concrete;
- b) CIRIA Report C530 – On-site curing of concrete;
- c) CIRIA Report C559 – Freeze thaw resisting concrete;
- d) CIRIA Report C569 – Concrete technology for cast in-situ foundations;
- e) CIRIA Report R135 – Concreting deep lifts and large volume pours;
- f) CIRIA Report R136 – Formwork striking times;
- g) CIRIA Report R139 – Water-resisting basements - a guide;



- h) CIRIA Report R146 – Design and construction of joints in concrete.

3.3 Inspection

3.3.1 General

- 3.3.1.1 Structural assets form a fundamental part of the LU system. The ability to maintain these relies to a large extent on effective regular inspection. Effective inspection requires an understanding of the structural assets encountered, how they work, their possible weaknesses together with a knowledge of tell-tale signs of problems and often where to look for them. In addition to these requirements effective inspections gather detailed, accurate, well presented and objective information to permit other members of staff (not directly involved in the inspection) to understand the problems, draw conclusions and take action where necessary. Even when no action is taken after an inspection a complete and objective record of what was found is essential to permit the next inspection to measure or assess any deterioration during the intervening period.

3.3.1.2 Bridge Structure types

Typical examples of bridge structure assets are given in Attachment 7.1.

3.3.1.3 New, modified or newly acquired structural assets

This Section provides general guidance for when newly constructed or modified structures are being inspected or where a structure has recently been acquired. The following information should be obtained to enable the basis of the inspection file to be prepared.

- a) General details include the following:
- I) as built' drawings of the structure, design calculations and material specifications and maintenance manuals and the maintenance certificate;
 - II) general description, including structure type, location, purpose and details of what it supports, (e.g. road name and number, buildings, machinery);
 - III) structural asset reference number;
 - IV) overall dimensions, confirming dimensions shown on record drawings dimensions should include headroom and horizontal clearance to running rails.
- b) Construction details:
- I) An alphabetical list of structure and element types is given below, together with the information that is required for inspection of a new structure. This information should be included in Part 1 of the Inspection Report – Form A0a (See Attachment 7.3).



Abutments	length, height, construction
Approach walls	length, height, construction
Arches	span, skew or square, number of rings, ring thickness etc, profile, round, elliptical, rise of arch
Bearings	rocker, roller, sliding, fixed plate
Covered Ways	span, abutment and deck description, details of property or roadway over
Culverts	brick, concrete, steel or glazed stoneware, cross section, barrel, or deck length and span, (the latter square with track and skew, if applicable) depth underline; headwalls, manholes, direction of flow, sewer including name if applicable
Decking & flooring	plate, jack-arch, timber, pressed steel, troughs, concrete

c) Additional information:

- l) All inspections, particularly the inaugural inspection should attempt to collect any relevant information that is considered useful to subsequent inspection and maintenance exercises. This information should include any special safety or access requirements to inspect the structure in the future and the name of the borough or county in which the structure is situated.

3.3.2 Types of Inspection

No specific advice

3.3.3 General Inspections

Guidance on structure inspection – Preparation

- 3.3.3.1 Good preparation is essential to the carrying out of safe, effective and efficient inspection work. Due to the numerous constraints of working on or near the railway, the demand for observance of safe working and the cost of site inspection work is high, whilst the time available usually very limited. It is therefore important that time and resources be used safely and productively.
- 3.3.3.2 Preparation involves familiarisation with the structure (known by its discrete asset identification number), its scale and the type and location of access. The inspection history should be investigated by reference to the previous inspection reports so that equipment required on site or any special access requirements, can be identified.
- 3.3.3.3 Final preparation work before the inspection should include further detail reference to the inspection records from which the following should be acquired:
- a) the form and extent of the structure (a number of complicated, often interconnected and similar structures can lead to confusion, with whole or parts of structures being incorrectly inspected or not being inspected at all;
 - b) copies of outline drawings (preferably to a known scale upon which inspection details can be marked on site;
 - c) copies of relevant detail information from earlier reports (e.g. locations of cracks and measurements);



- d) copies of relevant report pro-forma (the appropriate section of this manual for the structures to be inspected gives the description and reference numbers of relevant report pro-forma);
 - e) confirmation of all the arrangements described in (b) above revised where necessary to take account of the review of records.
- 3.3.3.4 Confirmation should be obtained prior to inspection that all personnel involved in the work have attended the relevant training courses mandatory for work on or near the railway.
- 3.3.3.5 A complete and thorough file record check of the structures to be inspected should be made to the satisfaction of the inspection supervisor and all relevant information abstracted from them. Any shortfalls of information in the inspection records and checks on their authenticity should be completed. In pre-inspection discussions particular problems and peculiarities relating to the inspection should be raised so that potential difficulties can be resolved before embarking on the site work.
- 3.3.3.6 Checks should be made before proceeding to site that all necessary equipment, notes and other material to carry out the inspection are available. Any additional keys that are required to gain access to stations or other closed areas should be collected and correctly signed out. Arrangements made with Outside Parties (e.g. to gain access to commercial premises for inspection) should also be confirmed. In addition a detailed programme of the work intended to be undertaken should be left with the inspection supervisor including the date, time and location of the proposed activities.

Guidance on structure inspection – Access equipment

- 3.3.3.7 Whilst the range and capabilities of modern access plant has advanced greatly in recent years, the scope for use of these machines on the system is limited. These limitations are generally associated with time and actually getting such machines to the site. The range of access equipment generally used in the course of inspection work on LU property should therefore be simple, quick to erect and readily transportable.
- 3.3.3.8 Experience has shown that inappropriate or inadequate access provisions are probably the greatest source of potential danger and delay in the course of inspection work. To avoid these problems, care and planning should be exercised in the selection of access equipment and observance of all safety guidelines should be exercised when the equipment is actually in use.
- 3.3.3.9 The ideal method of inspection is to gain 'hands on' contact with all accessible parts of a structure. The feasibility of achieving such close contact should depend on it being safe, practical and efficient. The access equipment that best satisfies these criteria should be selected, with the emphasis on safety.
- 3.3.3.10 Certain structures with access problems may be scaffolded out periodically for renovation work. A detailed inspection of these structures should be made when such scaffolding is in place.
- 3.3.3.11 All permanent means of access should be used with caution, their existence does not necessarily guarantee their safety. The types of permanent access that may be encountered include fixed ladders, staging, climbing rungs, gantries, cat walks and suspended platforms. All such permanent access provisions should form part of the inspection and should be inspected before use. In all cases where the safety of a permanent access provision is in doubt an alternative must be found.



- 3.3.3.12 At the site of the inspection all reasonable efforts should be made to check and satisfy that access facilities are adequate and safe. Access equipment should be used strictly in accordance with current standards and the Supplier' Health, Safety and Environmental Management System.
- 3.3.3.13 Where access involves gaining entry to other areas such as commercial premises under, over or adjacent to structures, arrangements should be made in advance with the occupiers and tenants of the premises.
- 3.3.3.14 Where access from the public highway is required then arrangements should be made in advance with the highway authority responsible for traffic management.
- a) Particular care must be taken to ensure the safety of both the inspectors and the public.
 - b) Where reasonably practicable, inspections should be designed to avoid or minimise the need for traffic management. If this is unavoidable then the highway authority should be consulted regarding the protection arrangements required to ensure safe working for the inspection staff and safe conditions for the highway users.
 - c) In any situation where there is considered to be a danger to either members of the inspection team or to other highway users then work should stop and advice be sought on how to proceed safely.
 - d) All those persons involved with the inspection within the highway boundary should wear high visibility outer clothing.

Guidance on structure inspection – Inspection equipment

- 3.3.3.15 The choice of equipment should be tailored to some extent to suit the inspection work being undertaken. Some items of equipment may however be classed as essential in all circumstances, namely:
- a) personal protective equipment;
 - b) a note book and pen (or other means of recording information);
 - c) a watch or clock;
 - d) Vulnerable Structures notice and red/white hazard tape.
- 3.3.3.16 The minimum requirement for equipment taken to site for inspection work should be all the items that could be used during that particular inspection shift or visit. Typically these items will include:

Basic requirements		Additional requirements	
	Safety equipment		Lighting
	Note book		Reporting materials
	Watch		Measuring tools
	Warning sign and hazard tape		Marking materials
			Camera and flash
			Binoculars
			Hand tools
			Hand held computer

Guidance on structure inspection – Inspection procedure



3.3.3.17 The inspection procedure may be summarised as follows:

- a) Establish site
- b) Preliminary review, recording essential details, general photographs
- c) Close examination, defect photographs
- d) Final review
- e) Clear site

3.3.3.18 On arrival at site the extent and nature of the structure should be ascertained and checks made that this conforms to the file records. Any apparent discrepancies should be noted immediately.

3.3.3.19 The first stage of the inspection proper should comprise a preliminary review of the structure, checking its general form, component parts and evidence of any repairs or alterations that may have been carried out since the last inspection. In all events, essential details as given below should be recorded. The list should not be seen as exhaustive and discretion should be used to add any further information seen as relevant.

Essential details	Notes
Preliminary details:	Structure number and location, date, weather and temperature, inspectors' names
Minimum headroom measurement:	Position of minimum headroom should be located bridges and structures over roads and track
Low bridge and restricted width signs:	position, nature and condition of such signs on highways as well as the track
Type of track	including method of retention and support
Presence and extent of cladding or hoarding:	including the nature of structure or concealed components if known
Concealed metalwork:	where partially embedded or concealed making particular note of condition at interface
Any confined spaces:	including facilities for ventilation (if any) and general condition where this can be verified without entering
Any repairs, outstanding or completed since the last inspection:	including location and extent
Fencing, wall and entry/exit provision defects:	especially those that permit trespass onto the railway
Change in road use or name:	including pedestrianisation, closure or width and loading restrictions
The presence of rail joints over Underbridges, subway (including tube) and culverts:	including the location and number
Signs of vandalism and graffiti (notify the line operator if graffiti is offensive):	especially within LU Property
Structures or parts of structures over sidings or other areas subject to unusual current on/off times:	including any local variation of engineering hours
Areas not visible for inspection:	including those areas covered by vegetation, dirt and other deposits