

**TECHNICAL USER MANUAL
for
STANDARD WALKWAY AND APPROACH DETAILS**



Summary

This technical user manual is applicable to the standard walkway details for Network Rail's standard half through, box and concrete underbridges. It provides guidance on the selection and application of Network Rail's suite of standard drawings. The standard walkway designs and details will generally be used for new-build structures, however walkways may also be suitable retrospective erection onto existing structures and non standard underbridge types.

Issue record

This technical user manual will be updated when necessary by distribution of a complete replacement. A vertical black line in the margin will mark amended or additional parts of revised pages.

Revision	Date	Comments
A	December 2008	Issue for review
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1 INTRODUCTION TO STANDARD DESIGNS AND DETAILS

The development of the Standard Designs and Details (SDD) has been undertaken by Network Rail to improve safety, asset reliability and increase efficiency. Their development is linked to Network Rail's overall business objectives, to improve reliability of the railways and reduce the funding requirements for on-going management and maintenance of the network. The basis of the SDD focuses on two main areas that derive from these issues:

- Ensuring that the design meets Network Rail's requirements
- The design is as successful as the designs of previous railway engineers, who built and maintained bridges that have given good service for approaching 150 years.

The use of the SDDs is promoted from the highest level within Network Rail. Alternatives to the SDDs will only be considered where it can be demonstrated that a SDD cannot be used and must be agreed with Network Rail's professional head of civil engineering. Failure to use a SDD may lead to project authority being withheld.

1.1 Network Rail's Requirements

Network Rail's requirements are split between two areas, delivery and function:

1.1.1 Delivery Requirements

The SDDs have been taken to a stage where Form As and Form Bs for each aspect covered (underbridge design, ancillaries etc.) have been submitted and approved. This leads to the following benefits:

- A reduction in the design development timescales and costs.
- Minimising contractor and sub-contractor costs associated with uncertainties in detailing requirements.
- Streamlining the technical approval process for commonly used designs and details.

1.1.2 Functional Requirements

The SDD have been designed to ensure satisfactory performance of the asset under both normal operations and abnormal operations (both planned and unplanned). A further consideration has been Network Rail's requirement to reduce the volume of maintenance and management costs through the adoption of good practice. This leads to a number key design drivers including:

- Failure modes: Critical failure modes should give warning, and alternative load paths should be provided for potential local failures.
- No hidden details: All main structural elements should be visible from at least one side.
- Robustness: It is desirable for elements of the structure to have a degree of robustness so that they are not damaged by unforeseen events disproportionate to the cause.
- Capability to support load.
- Acceptable deformations.
- Structure gauge requirements: The walkway and approaches details have been designed to cater for a range of positions of the structure gauge allowing their wide use.
- Safe working environment: The walkway and approaches have been designed to minimise the risk to people on or about the bridge.

These functional requirements are requirements of draft Network Rail standard NR/L2/CIV/020. Draft 012 of this standard has been used and the requirements therein met in designing the standard walkway and approaches details.

A library of standard designs and details for standard walkway details that can be attached to Network Rail's standard half through, box and concrete underbridges has been produced. This document contains guidance on the use of these standard drawings, including advice on the following:

- The elements and options contained within this suite of standard designs and details.
- Instruction on configuring a design using the standard designs and details
- Specific design restrictions and design assumptions
- Installation guidance
- Safety/CDM/environmental issues

The library will be maintained and distributed by Network Rail to its stakeholders and key external suppliers for adoption across the network at a national level.

2 GUIDANCE FOR USE OF NETWORK RAIL STANDARD DESIGNS AND DETAILS

The underlying philosophy of this standard is that a single basic standard walkway and approaches (stairs or ramps) design is provided that can be attached to and cantilever from any of the Network Rail standard underbridge designs:

- D type half through underbridge
- E type half through underbridge
- U type half through underbridge
- Z type half through underbridge
- Concrete underbridge structures
- Standard (Western) box underbridge

The standard walkway has been designed to accommodate suitable alternative details, where appropriate and agreed with Network Rail.

Standard details and options are given for the approaches on to the walkways from the substructure.

The flowchart in Figure 2.1 demonstrates the use of the technical user manual and standard drawings. The designer should analyse the constraints and requirements that exist for the specific project site. This information should be used in conjunction with the design advice contained within this technical user manual, to decide which elements can be taken from the library of standard designs and which details and items, if any, need bespoke design. This designer's output, and the series of standard drawings can be combined to produce the final walkway and approach arrangement for the particular scheme.

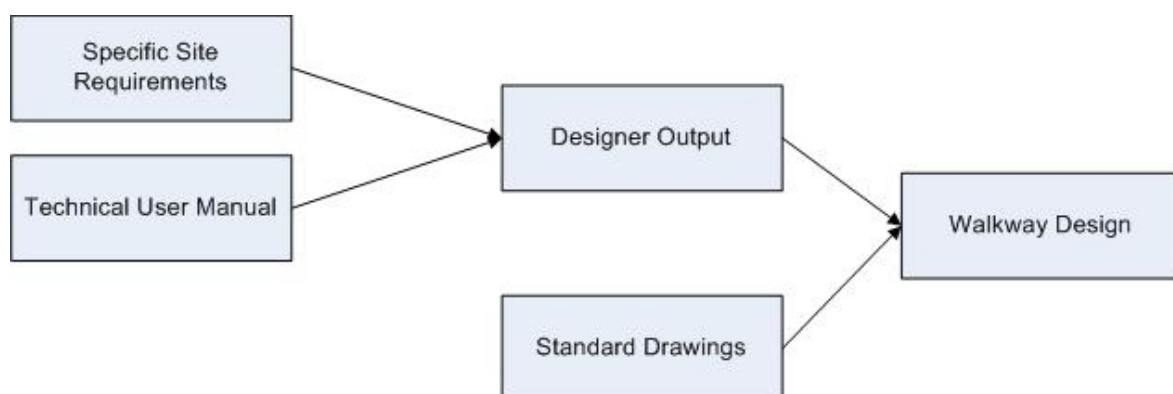


Figure 2.1: Flowchart to show the use of Network Rail's Standard Details and Designs

This manual describes the standard walkway details and approaches on to the walkways from the substructure. It is intended to be read in conjunction with the set of Standard Drawings listed in Appendix A and aid the designer in producing an individual walkway design, or a complete bridge design using this standard, or in comparing this standard with other solutions:

Reference in this User's Manual to 'Standard design' or 'Standard Drawing(s)' does not imply that the use of the walkway and approach design is mandatory. The design is a model that is available for use in appropriate circumstances.

Scheme specific design is required to determine the geometry of the walkway and the approach details. The designer will have to also have to produce survey, proposed general arrangement, substructure details, track layout and levels and setting out drawings, as necessary.

The standard drawings shall not be redrawn or modified. Any required changes (e.g. when defining geometry or facilitating construction methodology) shall be shown on a separate drawing that clearly identifies the affected details.

The standard walkway and approach details have been designed to cater for a wide range of geometrical constraints. For situations outside these parameters, the standard design cannot be assumed to be applicable. Equally it will be obvious that the standard walkway design here, in catering for such a wide range of circumstances, will inevitably involve conservatism on specific aspects and for specific arrangements. Thus it may be possible to use the existing design in whole or part outside the given limits without modification, or to achieve a more economic and less substantial design within those limits, but again in both cases they will need a full re-design, and an appropriate check. These are matters that will need discussion with Network Rail's project sponsor and Network Rail's professional head of civil engineering if such a course of action is favoured.

2.1 Approval of Schemes Using Standard Designs & Details

The SDDs for each walkway and approach option have been submitted and approved by Network Rail at both Form A and Form B (including a Category III Check) stages of the Network Rail approvals process in accordance with NR/CIV/SP/003 Issue 2. The flowchart in Figure 2.2 demonstrates the general process of using the SDDs and TUMs. The blue shaded boxes assist the designer to select the appropriate details or confirm the suitable options available.:

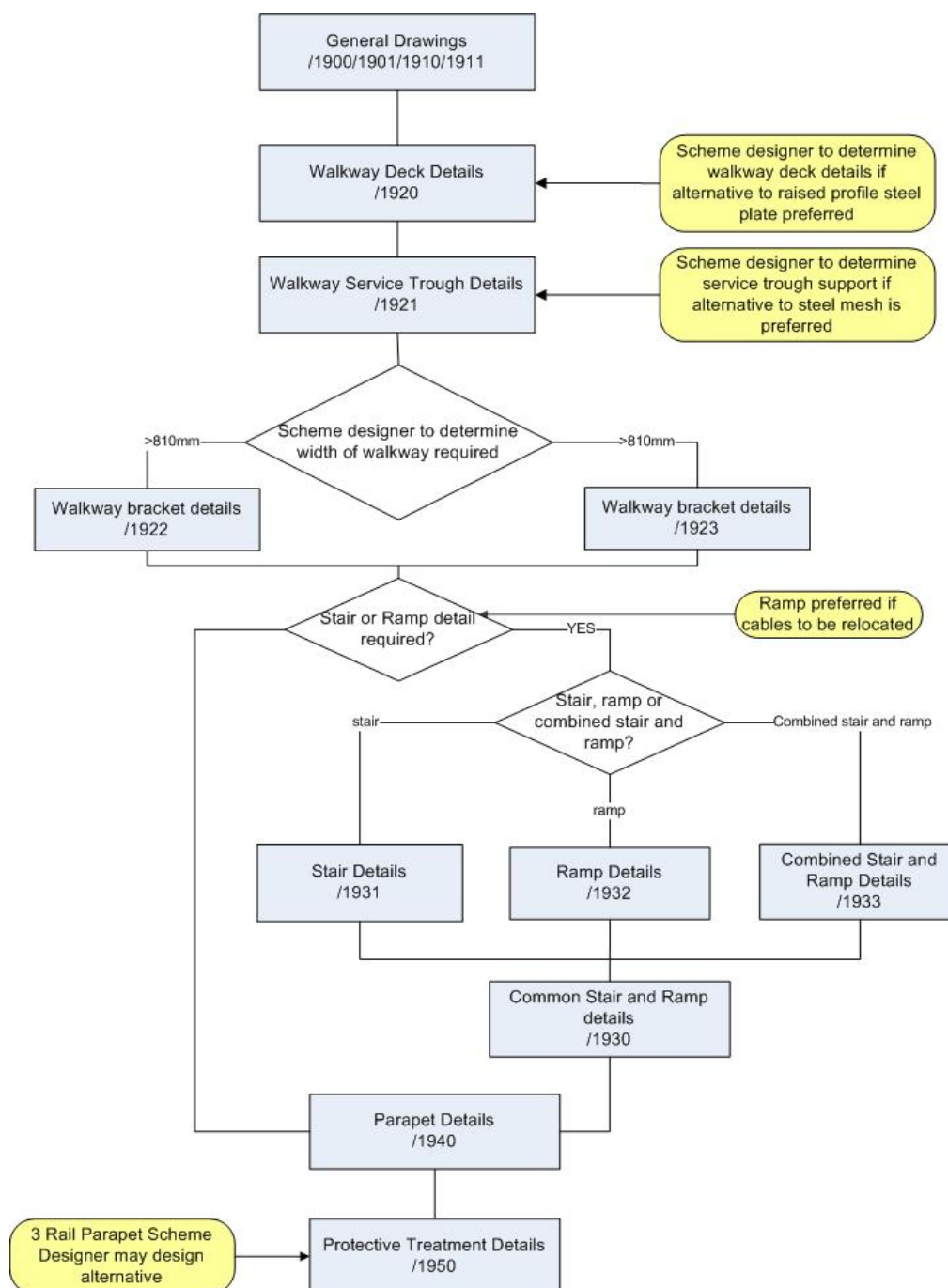


Figure 2.2: Flowchart to show how to determine which of Network Rail's Standard Details and Designs to use in detailing a standard walkway and approach

- The designer will need to produce a scheme specific Form A for the site under consideration. This Form A will detail the site specific parameters and the SDDs that will be used.

2.2 Modifications to Standard Designs & Details

Modifying the standard designs and details will only be accepted by Network Rail where the modifications can be justified technically and where it can be demonstrated that the modifications will not incur any significant additional whole life cost to Network Rail. Any modification invalidates the Standard Designs and Details Form As and Form Bs. In the event that modification is proposed the following justification must be provided:

- Technical justification considering structural capacity, longevity with respect to fatigue and reserves for future corrosion allowance:
 - Form A documentation.
 - Form B documentation.
- Cost justification
 - Estimate of the increased cost of maintaining non-standard assets.
 - Estimate of the increased cost of managing non-standard assets.
 - Estimate of the increased cost of additional Network Rail approval and review costs.

3 GLOSSARY AND LIST OF STANDARD DETAILS AND OPTIONS

The standard walkway components are summarised in the Figure 3.3 below:

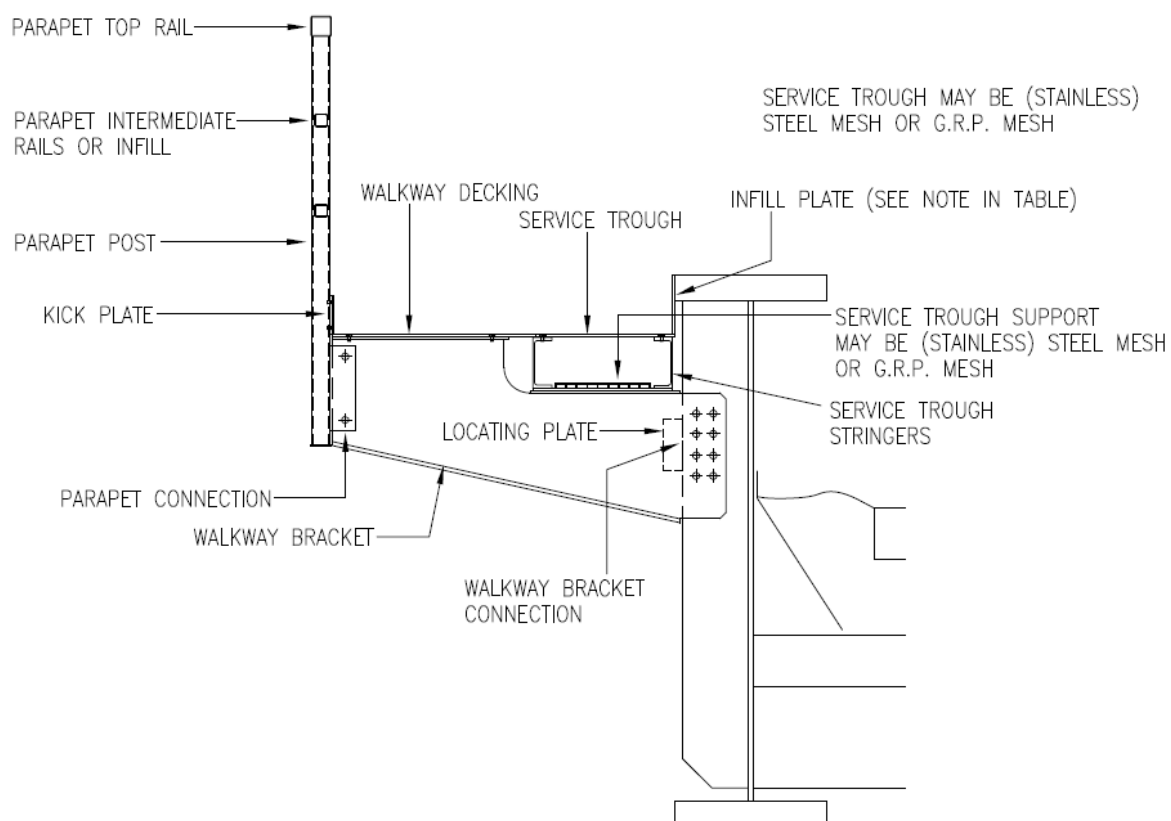


Figure 3.3: Standard walkway components

The standard walkway and approach component level of design and opportunity for options are summarised in the following table:

Component	Standard Detail	Options Possible	Comment
1.25m three rail parapet	Yes	Yes	Alternative parapet details possible. Walkway bracket, walkway bracket connection and standard underbridge designs can accommodate a 1.5m solid parapet.

Component	Standard Detail	Options Possible	Comment
Parapet connection	Yes	Yes	Scheme specific detail required if standard 1.25m three rail parapet not used.
Walkway Bracket	Yes	No	Geometry determined by designer
Walkway Bracket Connection and Locating Plate	Yes	No	Standard details are suitable for parapet options, loading and walkway arrangements described herein. Bolt arrangement suitable for all standard underbridge types listed. Any change to the bolt arrangement will necessitate modification to the standard underbridge details and is therefore not recommended.
Kick Plate	Yes	Yes	Alternative material may be specified. To be approved by Network Rail.
Service Trough Stringers	Yes	No	N/A
Service Trough Support	Yes	Yes	Alternative material may be specified. To be approved by Network Rail.
Infill Plate	No	N/A	Scheme specific. Only required on very deep bridge girders where top flange >500mm above ballast level. Recommended that vertical distance between bottom flange and walkway bracket >500mm.
Service Trough	Yes	Yes	Alternative material may be specified. To be approved by Network Rail.
Walkway Decking	Yes	Yes	Alternative material may be specified. To be approved by Network Rail.
Approach Stairs	Yes	Yes	Alternative material steps fabricated from may be specified. To be approved by Network Rail.

Component	Standard Detail	Options Possible	Comment
Approach Ramps	Yes	Yes	Alternative ramp surface material or material steps fabricated from may be specified. To be approved by Network Rail.
Approach Combined Stair and Ramp	Yes	Yes	Alternative ramp surface material may be specified. To be approved by Network Rail.
Approach Landing	No	N/A	Scheme specific.
Anchor bolts in concrete bridge types	No	N/A	Scheme specific.
Facia Panel	No	N/A	Scheme specific.

Table 3.1: Table listing the standard walkway and approach component levels of design and options

4 DETAILS OF STRUCTURAL FORM

There are two broad approaches to the provision of walkways. One is to cantilever them off the bridge structure, the other is to provide them as a separate structure.

The designer will need to make a judgement as to the appropriate solution as an independent walkway structure may in some cases be more appropriate: Separate walkway structures can also act, if suitably designed, as protection beams to the main superstructure where there is a particular risk of "bridge bashing" by vehicles passing underneath. The main disadvantage will be that where an existing substructure is being reused, its width may be inadequate to seat the walkway beams, necessitating either cantilevered imposts / cill units or separate independent supports.

This standard design however, considers only the former approach.

4.1 Geometry and Configuration

The designer shall consider the track alignment, cant effects, possible future realignment and line speed (current and future) to ensure that the appropriate walkway and approach width is determined. The designer will need to utilise the following Network Rail and Railway Group Standards, Specifications and Guidance Notes :-

- GE/RT8073 Requirements for the Application of Standard Vehicle Gauges
- GC/RT5203 Infrastructure Requirements for Personal Safety in Respect of Clearances and Access (superseded)
- GC/RT5212 Requirements for Defining and Maintaining Clearances
- GE/GN8573 Guidance on Gauging
- NR/SP/TRK/015 Structure Gauge Policy
- NR/SP/OHS/069 Lineside Facilities for Personal Safety
- NR/L2/CIV/020 Design of Bridges and Culverts

The width of the standard walkway horizontal surface has been determined by providing the required clearance from the track (line speed specific) and the minimum width required for a safe access walkway (700mm). The minimum standard walkway detail is therefore 700mm wide.

In determining the maximum walkway width it is assumed the lower sector structure gauge, with $X = 760\text{mm}$ (in accordance with GC/RT5212), is positioned tight against the inside face of the top flange of a standard Z type or U type, i.e. a minimum top flange width of 300mm. With the minimum clearance to the walkway given in NR/SP/OHS/069 (1300mm at 160kph/100mph

or 2100mm at 200kph/125mph) this gives the maximum walkway width = 1740mm. This is shown diagrammatically on Figure 3.4.

The maximum span of a standard Z type or U type is 17m and 20m respectively and the minimum track radius that can be accommodated within the Z type and U type constraints is 1260m where the line speed exceeds 160kph/100mph. NR/SP/OHS/069 requires additional allowances for cant and end throw to be included where the track radius is 1000m or less. This is not applicable to the standard Z type or U type but the designer must include these additional clearances where the standard walkways are used on decks other than the standard Z type and U type, and where the track radius is 1000m or less.

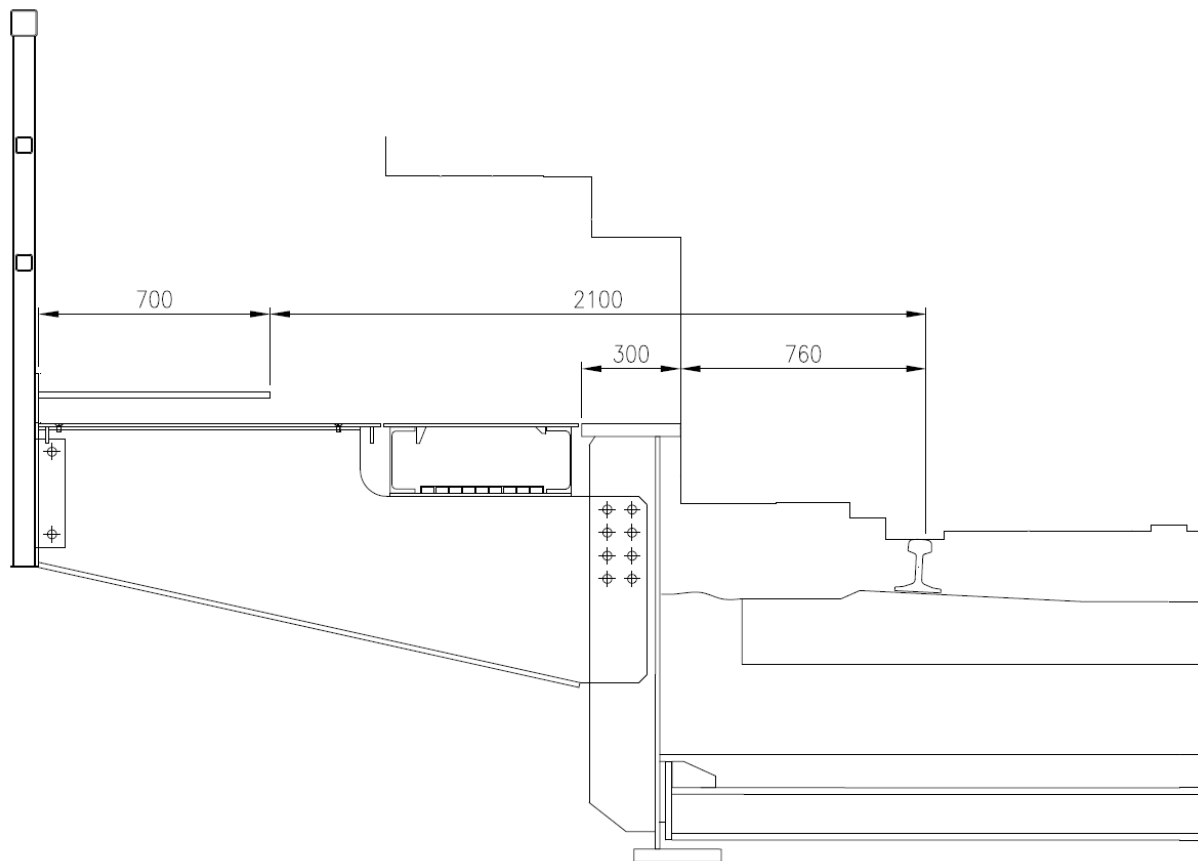


Figure 3.4: Diagrammatic arrangement of the maximum standard walkway bracket width

4.2 Vertical positioning of walkway

The headroom is site specific and the designer shall ensure the suitability of using the standard design details. To minimise the risk of impact from vehicles underneath the bridge, the lowest part of any walkway should not normally be less than 500mm above the main girder bottom flange.

Where very deep girders are used, such as long span E type girders, it may not be appropriate to place the walkway at the main girder top flange level. Where direct access to the walkway cannot be achieved, i.e. the step from the ballast level to the walkway level is greater than 500mm, the walkway may be positioned at a lower level. Due consideration must be given to the increased risk of impact from vehicles underneath the bridge. This lower position may assist relocation on lineside cabling. When the walkway is not at the top flange level, an additional inner kick plate may be required.

5 STANDARD COMPONENT DETAILS

5.1 Walkway bracket

The Standard Drawings show walkways suitable for use on underbridges with line speeds up to and including 200kph/125mph only. Two arrangements are shown, with a service trough to accommodate cable ducts common to both:

- Type 1 standard walkway where a wide walkway is required and the walkway width is wider than the service trough width.
- Type 2 standard walkway where the walkway width required is as wide as or less wide than the service trough width.

The designer will determine the walkway type most appropriate after considering the geometric constraints, railway traffic and line parameters.

The two walkway bracket types are effectively a fabricated I section with varying properties along its length. The slope of the web / bottom flange was determined to suit all walkway widths and ensure adequate space for a standard walkway bolt connection.

5.2 Walkway bracket connection

Bolted connection arrangements are detailed for attaching the standard walkways to bridge girders with or without external web stiffeners, or attached to concrete decks with cast in anchor bolts (scheme specific detail). The bolt arrangement is constant, irrespective of the available space available, to ensure compatibility with the hole details for the standard underbridge designs. Note that the designer must specify the vertical position of the bolts if an

alternative walkway decking or service troughing is specified and thicker than the standard detail shown on drawing NR/CIV/SD/1920.

5.3 Service trough stringers

Parallel flange channels span between and are bolted to the walkway bracket top flanges. In between the walkway brackets the service trough stringers are connected together by gusset plates at centres not exceeding 500mm.

5.4 Approach arrangement

The standard drawings show walkway approaches suitable for use with the standard walkways. Arrangements are shown, with a service trough to accommodate cable ducts common to all for:

- Stair only approach
- Ramp only approach
- Combined stair and ramp approach

Where the walkway is combined with a lineside service route and positioned at the main girder top flange / box top flange / concrete upstand level, consideration must be given to the flexibility and slack in the cables to be accommodated. Where possible, to avoid damaging existing cables to be relocated, a shallow ramp is the preferred approach option. However, the designer must ensure adequate space if possible for such an approach detail.

Approach details may be welded to the walkways or a bolted splice used. Details are given on the standard drawings. The designer must consider the installation sequence to ensure the approach can be landed and attached without affecting subsequent site activities. Refer to Section 7.

The designer's attention is also drawn to the requirement that whichever approach detail is used, the designer is responsible for detailing the landing for the approach and ensuring suitable ballast retention details are provided, preventing ballast spilling from the approach or fouling stairs.

5.5 Protective treatment

The standard protective treatment required of the steel components of the standard walkway and approaches is N1 in accordance with NR/GN/CIV/002. Details, including faying surfaces and anti-slip treatments, are given on drawing NR/CIV/SD/1950.

6 OPTIONS FOR ALTERNATIVE DETAILS

6.1 Walkway decking and service trough

The walkway decking and service trough details given on the standard drawings comprises a profiled (non slip) 10mm thick steel plate. The walkway decking is stiffened longitudinally and spans between its point of fixity (bolted connection) at the walkway brackets whereas the service trough spans transversely between service trough stringers to which it is secured.

However, the designer, with the approval of Network Rail, may consider an alternative suitable for the particular site. Such alternatives may include an open walkway decking or service trough formed of FRP or stainless steel, or a solid steel deck with a non slip coating applied.

The loading from the solid plate was considered only and the alternative details must therefore not exceed the weight of the standard walkway decking or service trough for the design of the other standard walkway components to remain valid.

The use of FRP is becoming more popular and if approved for use by Network Rail, the designer or manufacturer shall ensure such details are designed in accordance with current best practice.

6.2 Service trough support

As with the walkway decking and service trough, other materials such as FRP used as an alternative to the open stainless steel mesh shown for the service trough support on the standard drawings. The designer is responsible to obtaining approval for the use of such materials from Network Rail, and ensuring the compatibility of such details with the supporting structure and the services it supports.

The loading of any alternative service trough support must not exceed 0.27kN/m^2 (nominal) for the standard design of the other standard walkway components to remain valid.

6.3 Parapets

The standards parapet details given on the standard drawings comprises a 1250mm (above walkway) three rail painted steel parapet. However, the designer, with the approval of Network Rail, may consider an alternative suitable for the particular site.

The standard walkway bracket and walkway bracket connection detail can accommodate parapet arrangements with varying height between the minimum 1250mm and maximum 1500mm. The parapets may be open (such as the standard three rail or vertical bar parapet) or solid (such as GRP infill panels).

In all cases the parapet is provided along the edge of the walkway and is supported by vertical posts attached to the walkway bracket. The standard parapet connection is suitable for the standard 1250mm three rail parapet only. Where a non standard parapet is required, the designer shall detail the parapet connection.

The loading of any alternative parapet must not exceed 0.70kN/m (nominal) for the standard design of the other standard walkway components to remain valid.

6.4 Kick Plates

The designer may consider the use of other materials such as FRP used as an alternative to the 150mm wide, 10mm thick steel plate shown for the kick plate on the standard drawings. The designer is responsible for obtaining approval for the use of such materials from Network Rail, and ensuring the kick plate is securely fastened to the parapet.

The loading of any alternative kick plate must not exceed 0.20kN/m (nominal) for the standard design of the other standard walkway components to remain valid.

7 FABRICATION AND CONSTRUCTION

The standard cantilevered walkways are detailed to permit erection in the following manner:

- Install approach landing (if required, scheme specific detail).
- Bolt walkway brackets to main girder stiffeners / webs / upstands adjusting for line and level then fully bolt up.
- Offer and locate handrail units onto walkway brackets in turn.
- Install service trough support.
- Attach walkway approaches (if separate unit).
- Install walkway decking (if required).
- Install service trough.
- Offer up and install kick plate, minimising horizontal gaps and noting each length of kick plate to be secured in at least two locations.

- Place any ballast retaining detail at the ends of the approaches as required to stop ballast falling through the approaches or fouling the stairs.

The standard walkways can be erected within a possession, or if the underbridge is being replaced, attached to the replacement underbridge prior to the main possession. The latter will minimise the amount of work required such as applying protective treatment etc. at height and adjacent to a live railway, and should be encouraged.

Careful consideration of the construction sequence is required to ensure any cables or ancillary items to be installed after the main deck are not fouled by the presence of the attached walkway and any approach units.

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8 SAFETY/CDM AND ENVIRONMENTAL

8.1 Safety

The general (non site specific) risks associated with the walkway and approach design, construction and operation are listed on drawing 1901. The design has minimised the weight of the components that would be expected to be lifted during operations such as accessing lineside cabling by removing the service trough covers. Details to ensure the cover plates are securely tied down to avoid being sucked up from passing trains or removed by trespassers are given on the standard drawings.

As the designer has to determine scheme specific geometry for the majority of the standard walkway and approaches components, individual lifting weights and centres of gravity have not been calculated; this shall be done by the designer.

In addition there may be others arising from site-specific considerations, such as the presence of Overhead Line Equipment (OHLE) or vulnerable services.

8.2 Environment

Environmental issues can only be determined on a site specific basis.

The environmental impact on a particular site should, as a minimum, assess:

- The aesthetic effect of the walkway's presence.
- The effect of renewing the walkway protective treatment, particularly if:
 - An open mesh detail requires protection.
 - The site is in the vicinity of any watercourses.

Alternative materials to the steel plates detailed for the walkway decking, service trough, service trough support and parapets should be considered as they may offer both safety (lighter weight) and environmental (aesthetics) benefits. Alternative materials shall be agreed with Network Rail and must ensure the equivalent levels of robustness and safety as the standard walkway component details.

Appendix A SCHEDULE OF STANDARD DRAWINGS

Drawing	Description
NR/CIV/SD/1900	INDEX OF DRAWINGS
NR/CIV/SD/1901	GENERAL NOTES & HEALTH & SAFETY RISK REGISTER
NR/CIV/SD/1910	KEY TO COMPONENTS
NR/CIV/SD/1911	GENEREAL ARRANGEMENT & GEOMETRY
NR/CIV/SD/1920	WALKWAY DECK DETAILS
NR/CIV/SD/1921	WALKWAY SERVICE TROUGH DETAILS
NR/CIV/SD/1922	WALKWAY BRACKET DETAILS TYPE 1 > 810mm WIDE
NR/CIV/SD/1923	WALKWAY BRACKET DETAILS TYPE 2 700mm - 810mm WIDE
NR/CIV/SD/1930	COMMON STAIR AND RAMP DETAILS
NR/CIV/SD/1931	STAIR DETAILS
NR/CIV/SD/1932	RAMP DETAILS
NR/CIV/SD/1933	COMBINED STAIR AND RAMP DETAILS
NR/CIV/SD/1940	PARAPET DETAILS – THREE RAIL PARAPET & KICK PLATE DETAILS
NR/CIV/SD/1950	PROTECTIVE TREATMENT DETAILS

Appendix B HISTORY OF THE STANDARD WALKWAY DETAIL

Standard walkway details have historically been designed for both the standard Z type underbridges and box girder bridges. The historical box girder bridge drawings also included a number of walkway approach stair details. The most appropriate details from these have been used in developing this standard design for walkways and approaches considering:

- Flexibility to cover a wide range of geometrical constraint.
- Current best practice.
- Flexibility to ensure suitability for standard and non standard underbridge designs.
- Robustness leading to minimising maintenance.
- Safe fabrication, installation and maintenance.
- Ease of installation.
- Ease of fabrication.
- Flexibility on accommodating alternative component details.
- Secure details.

The details are shown on the drawings listed in Appendix A.

Appendix C DESIGN ASSUMPTIONS

The walkways have been designed to cantilever directly from the main girders, boxes or concrete upstands. Brackets are provided at a maximum of 1800mm centres. These support longitudinal spanning deck plates, service troughs and handrails as required. The walkway design only caters for speeds up to and including 200kph/125mph with a maximum width of 1740mm.

The loadings used in the design are stated below. If variation from those loadings is required the walkway design should be revised and the design recalculated accordingly. The design itself allows for a range of deck widths, choice of main girder sizes (relative to clearance requirements), choice of trackside cable position, choice of walkway and parapet types, etc., to allow the standard walkway and approach details to be used in a wide variety of situations.

C.1 Design Package and Calculations

The standard walkway and approach details have been designed in accordance with BS EN 1993-2:2006 and BS EN 1993-1-8:2005. The main exception is as regards loads and load distribution, which are in accordance with draft Network Rail Specification NR/L2/CIV/020 Draft 012, Design of Bridges & Culverts. No departures from standards or the draft specification were required in the development of the design.

C.2 Design Parameters

C.2.1 Physical Limits

- Minimum walkway width 700mm (type 2), 810mm (type 1).
- Maximum walkway width 1740mm (type1), 810mm (type 2).
- Walkway brackets and parapet posts positioned at centres not exceeding 1800mm.
- Parapets and kick plates jointed at centres not exceeding 5400mm.
- Stairs or ramps will be supported by the substructure (scheme specific detail) and the first cantilever on the bridge. The maximum approach span covered by the standard walkway details will not exceed 2500mm nor have a rise greater than 1000mm.

C.3 Design Assumptions

C.3.1 Structural Models

The walkway and approached were designed using simple statics and manual calculation.

C.3.2 Loading

The critical deck to main girder connection design has been based on the most onerous walkway load case assumptions. It is suggested that suitable notices are erected on each set of walkway handrails specifying a loading restriction to ensure these design loads are not exceeded, by rails or heavy machinery being placed on them.

The following is a summary of the design loads under current UK standards, BS EN 1991-2:2003 as amended by draft Network Rail Specification NR/L2/CIV/020:-

All Permanent Loads

- Self weight of steel components: 77kN/m^3
- Service route: 1kN/m ;

Walkway Personnel Loads

- 5kN/m^2 from railway personnel plus a point load of 2kN applied vertically (nominal).

Parapet Loads

- Combination 1: 0.74kN/m + a point load of 0.5kN applied horizontally at top parapet rail level, 1.5m above the walkway deck level (nominal).
- Combination 2: 4.44kN/m (wind) applied horizontally 0.75m below the top parapet rail (nominal).

The standard walkway and approach structures were designed assuming a parapet height of 1500mm . The parapets were assumed to be closed for the purpose of calculating load effects. The maximum fundamental basic wind velocity, $v_{b,\text{map}}$ considered was 29m/s . This gave a maximum fundamental basic wind velocity, $v_{b,0} = 35\text{m/s}$ assuming an altitude of 200m above sea level.

Wind load coexistent with walkway live load were combined in accordance with BS EN 1990:2002.

These loads were used for the walkway, parapet, walkway bracket, walkway bracket connection and main girder intermediate stiffener design.

The walkways have not been designed to support a derailed train.

Appendix D Draft 12 of NR/L2/CIV/020 Design of Bridges & Culverts

Ref	NR/L2/CIV/020
Issue	1 (Draft 12)
Date	2008

Level 2

Design of Bridges & Culverts

Endorsement & Authorisation

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Accepted for issue by:

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Issue Record

Issue	Date	Comments
1	 2008	New standard. Incorporates and supersedes RT/CE/S/007 : <i>Design loading for accommodation and occupation overbridges.</i>

Compliance

This Network Rail standard specifies mandatory requirements and must be complied with by Network Rail and its contractors **from.....**

It is permissible for projects that have formally completed GRIP Level 4 at the compliance date (i.e. acceptance of Form A in accordance with NR/L2/CIV/003: *Technical approval of design, construction and maintenance of civil engineering infrastructure*) to continue to comply with the Network Rail standards and other standards and requirements as identified in the Form A and not to comply with the requirements contained herein, unless otherwise stipulated in the accompanying Briefing Note or Network Rail's specific requirements for the project.

Reference documentation

Railway Group Standards

GC/RT5021	Track System Requirements
GC/RT5112	Loading Requirements for Design of Bridges
GC/RT5203	Infrastructure Requirements for Personal Safety in Respect of Clearances and Access
GC/RT5212	Requirements for Defining and Maintaining Clearances
GE/RT8073	Requirements for the application of standard vehicle gauges
GE/RT8025	Electrical Protective Provisions for Electrified Lines
GL/RT1253	Mitigation of DC Stray Current effects
GM/RT2149	Requirements for Defining and Maintaining the Size of Railway Vehicles

Railway Approved Code of Practice / Guidance

GC/RC5510	Recommendations for the Design of Bridges
GE/GN8573	Guidance on gauging.

Network Rail Standards

At the time of publication a new reference system for Network Rail standards was being introduced; the references given to the following standards are those anticipated to be adopted in their next issue.

NR/L1/CIV/044	Managing structures works
NR/L2/CIV/003	Technical approval of design, construction and maintenance of civil engineering infrastructure
NR/L2/CIV/017	Examination of Bridges and Culverts
NR/L2/CIV/035	Assessment of structures
NR/L2/CIV/037	Managing the risk arising from mineral extraction and landfill
NR/L2/CIV/039	Specification RT98 – protective treatments for Railtrack infrastructure
NR/L2/CIV/041	Waterproofing systems for underline bridges
NR/L2/CIV/067	Design of equipment support structures
NR/L2/CIV/071	Design of earthworks, earthwork remediations and geotechnical aspects of foundations for structures
NR/L2/CIV/076	Management of bridge strikes from road vehicles & waterborne vessels
NR/L2/CIV/140	Control and use of model clauses
NR/L3/CIV/001	Waterproofing for underline bridge decks
NR/L3/CIV/002	Application and reapplication of protective treatments to Railtrack infrastructure
NR/L3/CIV/008	Model clauses for specifying civil engineering works
NR/L3/CIV/025	The structural assessment of underbridges
NR/L3/CIV/202	Management of the risk of bridge strikes
NR/L3/TRK/030	Lineside security
NR/SP/ELP/21085	Design of earthing and bonding systems for 25 kV A.C. electrified lines
NR/SP/OHS/069	Lineside facilities for personal safety
NR/SP/TRK/038	Longitudinal timbers – design, installation and maintenance
NR/SP/TRK/102	Track construction standards
NR/SP/TRK/9006	Design, installation and maintenance of lineside drainage
RT/CE/S/007	Loads for occupation/accommodation bridges (<i>Superseded by this standard</i>)

Network Rail Structures Engineers Technical Advice Notes

SE/TAN/0038 Helical screwed pile foundations for equipment support structures

British Standards

- BS 5268 Structural use of timber:
Part 2: 2002: Code of practice for permissible stress design, materials and workmanship
- BS 5395 Stairs, ladders and walkways:
Part 3: 1985: Code of practice for the design of industrial type stairs, permanent ladders and walkways
- BS 5400 Steel, concrete and composite bridges:
Part 1: 1988: General statement
Part 2: 2006: Specification for loads
Part 3: 2000: Code of practice for design of steel bridges
Part 4: 1990: Code of practice for design of concrete bridges
Part 5: 2005: Code of practice for design of composite bridges
Part 9: 1983: Bridge bearings
Part 10: 1980: Code of practice for fatigue
- BS 5628 Code of practice for use of masonry:
Part 1: 2005: Structural use of unreinforced masonry
Part 2: 2005: Structural use of reinforced and prestressed masonry
Part 3: 2001: Materials, components, design and workmanship
- BS 6799 Highway parapets for bridges and other structures
Part 4: 1999: Specification for parapets of reinforced and unreinforced masonry construction
- BS 7818: 1995 Specification for pedestrian restraint systems in metal
- BS 8004: 1986 Code of practice for foundations
- BS 8110 – 1 Structural use of concrete.
Part 1: 1985 Code of practice for design and construction
- BS 8300: 2001 Code of Practice - Design of buildings and their approaches to meet the needs of disabled people
- BS EN 1317-2 Road restraint systems
Part 2: 1998: Performance classes, impact test acceptance criteria and test methods for safety barriers
- BS EN 1990: 2002 Eurocode – Basis of structures design,
Annex A2: Application for bridges
- Annex A2

BS EN 1991-1-7	Eurocode 1: Actions on structures Part 1-7: 2006: General actions – Accidental actions
BS EN 1991-2	Eurocode 1: Actions on structures Part 2: 2003: Traffic loads on bridges
BS EN 50122	Railway Applications – Fixed Installations: Part 1: 1998: Protective provisions relating to electrical safety and earthing Part 2: 1999: Protective provisions against the effects of stray currents caused by d.c. traction systems
BS EN ISO 12944-3	Paints and varnishes Part 3: 1998: Design considerations.
N.A.D. for ENV 1991-3: 1995	UK National Application Document for ENV 1991-3: 1995 Eurocode 1 – Basis of design and actions on structures – Part 3: Traffic loads on bridges

Highways Agency standards

BA 9/81	The Use of BS 5400: Part 10: 1980 Code of practice for fatigue
BD 9/81	Implementation of BS 5400: Part 10: 1980 Code of practice for fatigue
BD 20/92	Bridge Bearings. Use of BS5400: Part 9: 1983
BD 21/01	The Assessment of Highway Bridges and Structures
BD 29/04	Design Criteria for Footbridges
BD 30/87	Backfilled Retaining Walls and Bridge Abutments
BD 42/00	Design of Embedded Retaining Walls and Bridge Abutments
BD 60/04	The Design of Highway Bridges for Vehicle Collision Loads
BD 65/97	Design Criteria for Collision Protection Beams
BD 74/00	Foundations
TD 19/06	Requirement for Road Restraint Systems

Her Majesty's Railway Inspectorate

Railway Safety Principles and Guidance: Part 2	Section A: Guidance on the Infrastructure Section B: Guidance on Stations Section C: Guidance on Electric Traction Systems
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Department for Transport

Managing the accidental obstruction of the railway by road vehicles

Strategic Rail Authority

Code of Practice: Train and Station Services for Disabled Passengers

International Union of Railways

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UIC Leaflet 719-R Earthworks and track bed construction for railways
 UIC Leaflet 774-3R Track-bridge interaction. Recommendations for calculations
 UIC Leaflet 776-3R (1st Edition 1989): Deformation of bridges

American Association of State Highway & Transportation Officials (AASHTO)
 Load and resistance factor design (LRFD) – Bridge Design Specifications

Institution of Civil Engineers

Burland and Kalra: Queen Elizabeth II Conference Centre: geotechnical aspects,
 Proc. Instn Civ. Engrs, Part 1, 1986, 80, Dec., 1479-1503.

Disclaimer

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Supply

Copies of documents are available electronically, within Network Rail's organisation. Hard copies of this document will be available to Network Rail employees on request to the Document Controller and to other organisations from IHS (Technical Indexes Ltd) (01344 404409).

Comments

The applicability and content of this standard will be reviewed on a regular basis. Written comments on the accuracy and utility of this standard will be taken into account when assessing the need for a new issue of the standard; such comments should be sent to the Standards and Assurance Engineer (Civil Engineering) at 40 Melton Street, London NW1 2EE.

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1 Purpose

This Network Rail standard defines the requirements for the Design of Bridges and Culverts, and other structures within the scope of this standard.

This standard contains requirements supplementary to Network Rail standard [NR/L1/CIV/044](#): *Managing Structures Works*. Compliance with this standard and with the standards referenced herein will, in respect of the Design of structures within the scope of this standard, ensure compliance with [NR/L1/CIV/044](#) and Railway Group Standard [GC/RT/5112](#) (Issue 1: *Loading requirements for the design of bridges*). At the time of drafting this standard, [GC/RT/5112](#) was being revised for Issue 2. This standard complies with Draft 3b dated May 2008 of Issue 2 of [GC/RT/5112](#).

2 Scope

This standard applies to the Design of the following types of structure, to those involved with the Design, and to those appointed by Network Rail to be responsible for the management of such structures:

- Bridges,
- Culverts,
- avalanche shelters (loads for Design shall be agreed with Network Rail),
- cut and cover structures,
- pipe bridges (except as identified below in this Clause),
- structures that support buildings over operational railway lines (but not the buildings),
- subways,
- elevated vehicle forecourts and ramps,
- any other structure required by Network Rail to be designed as a Bridge or a Culvert.

Examples of structures that are within the scope of this standard are included in Structure Category A as shown in **Appendix A**. The scope includes all Bridge substructures, and earth retaining or wing walls that are integral with the Bridge substructure, and other earth retaining walls adjacent to the Bridge.

Intersection Bridges, which carry a railway over a railway, shall be designed for the applicable requirements of both an Underline and Overline Bridge.

Bridges which neither carry the railway nor span over the railway, shall be designed for the most onerous applicable effects according to what the Bridge carries and what the Bridge spans over.

For the purposes of this standard, the use of the terms Bridge or structure shall be deemed to include Culverts and any other structure within the scope of this standard where applicable.

This standard applies to the Design of:

- all Bridges that are, or will be, owned or managed by Network Rail,
- all Bridges that are Shared with Outside Parties,
- so far as is reasonably practicable, all Bridges that are owned by Outside Parties, where failure of the structure has a potential to affect the safety of train operations.

This standard also applies to:

- all stages where permanent works are Taken Into Use in stages before final completion,
- all temporary works, as defined in [NR/L2/CIV/003](#): *Technical Approval of design, construction and maintenance of civil engineering infrastructure*, that are provided for the execution of such Bridges.

The scope of this document covers the Design of the following categories of work:

- repairs,
- strengthening,
- replacement of parts,
- renewal / replacement of superstructures or substructures;
- new Bridges,
- temporary Bridges.

Where existing Bridges are to have parts repaired, strengthened or replaced (including the renewal / replacement of superstructures or substructures), the requirements of this standard shall apply to the Design of such parts and the consequential effects on other retained existing parts.

Retained existing parts do not need to comply with the requirements of this standard providing (a) the loads and effects on such parts will not be made more onerous by the alterations or the addition of other parts, (b) the retained parts are not showing any signs of distress, and (c) the load-bearing capability of the retained parts meets Network Rail's requirements. However, consideration shall be given to bringing retained existing parts into compliance with this standard where it is reasonably practicable and economic to achieve compliance. Where structural works are to be carried out, **10.10** identifies requirements to strengthen or replace weak existing parts.

This standard is applicable to Designs for conventional railway traffic at associated conventional speeds including:

- passenger rail traffic with maximum permitted speed not exceeding 125 mph (200 km/h),
- freight traffic with maximum axle weight of 25 tonnes and maximum permitted speed not exceeding 60 mph (100 km/h),
- freight traffic with maximum axle weight of 22.5 tonnes and maximum permitted speed not exceeding 75 mph (120 km/h).

For rail vehicles travelling in excess of the above speeds, guidance shall be obtained from Network Rail's Professional Head of Structures.

This standard does not apply to the Design of the following:

- longitudinal timbers, which shall be designed in accordance with [NR/SP/TRK/038](#): *Longitudinal Timbers – Design, Installation and Maintenance*,
- gantries for signals or overhead line electrification (OLE),
- cable bridges,
- pipe bridges for which the Design basis stated in the AIP Submission is [NR/L2/CIV/067](#): *Design of Equipment Support Structures*,
- Outside Party pipelines and other undertrack crossings,
- buildings or other structures that are supported by a Bridge.

Earthworks associated with a Bridge shall be designed in accordance with [NR/L2/CIV/071](#): *Design of earthworks, earthwork remediations and geotechnical aspects of foundations for structures*.

Equipment support structures that are attached to a Bridge shall be designed in accordance with the requirements of [NR/L2/CIV/067](#): *Design of Equipment Support Structures* as applicable.

This standard covers structural aspects of Design and those aspects of Design relating to the safe movement of users (including clearances) and the provision of adequate protection to users. However, it does not cover other health and safety aspects of Design, such as choice of materials (e.g. exclusion of lead based paints), ventilation, means of escape, access platforms and ladders.

This standard incorporates those parts of Railway Approved Code of Practice [GC/RC5510](#): *Recommendations for the Design of Bridges* which Network Rail requires to be mandatory. The requirements of this standard shall take priority over [GC/RC5510](#), which at the time of drafting this standard was due to be withdrawn. However, the additional information and guidance for the Design of Bridges available in [GC/RC5510](#) should be used where not in conflict with this standard.

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In order to address potential effects of climate change regarding temperatures, an additional 10°C has been added to effective Bridge temperatures – see **Appendix B**.

The principal standards for managing structures works are shown in [NR/L1/CIV/044](#): *Managing structures works*.

3 Roles, responsibilities and competencies

Those appointing persons to positions with responsibilities to deliver the requirements of this standard shall ensure that appointees are competent and that they understand their responsibilities. Appointments, responsibilities and duties shall be documented.

The skill, expertise, training and experience of those employed on a Design shall be appropriate to the nature and complexity of the structure being designed. This competency shall be assessed by the person making the appointment.

The Construction (Design and Management) Regulations 2007 set out requirements for those managing construction / Design work with respect to competency.

Roles, responsibilities and competencies of those involved in the production and checking of a Design, and its construction, shall be in accordance with [NR/L2/CIV/003](#): *Technical Approval of design, construction and maintenance of civil engineering infrastructure*.

The responsibilities of Network Rail's Infrastructure Liability Manager as regards this standard are identified in **6.7** and **9.4.1**.

4 Definitions

Accommodation Bridge

A Bridge provided to maintain access to lands that were severed by the construction of the railway and which can only legally be used by the successor to the original landowner whose land was severed; however, subsequent public footpath and bridle rights may have been acquired by other users.

AIP Submission

The submission for approval in principle as required by [NR/L2/CIV/003](#): *Technical Approval of design, construction and maintenance of civil engineering infrastructure*.

Authorised Walking Route

A designated route providing pedestrian access to and egress from places of work (including booking-on points and stabling points) and which is suitable for use by persons not certificated in Personal Track Safety.