

EUROCODE DESIGN TECHNICAL USER MANUAL

for

NON-STATION FOOTBRIDGES AND NON-CANOPY-STATION FOOTBRIDGES

Standard Detail and Design Drawings

This technical user manual is applicable to non-station footbridges and non-canopy-station footbridges. It provides guidance on the selection and application of Network Rail's suite of standard drawings. The standard designs and details within these drawings will generally be used for new-build structures, however elements may also be used for part replacement e.g. deck replacement.

Please email any comments and suggestions to SDCandOpsPropertyHandbook@networkrail.co.uk



Documents

Document Sharing Hub

Issue record

This technical user manual will be updated when necessary by distribution of a complete replacement.

The second issue of this Technical User Manual has been produced following a Eurocode update and feedback that Network Rail has received from its stakeholders.

Revision	Date	Comments
A	April 2008	First issue
B	July 2014	Revised following a Eurocode update and feedback
C	July 2015	Revised following further legislation and to incorporate 16m Standard Details.
D	July 2015	Added 3D stairs FEM model to Section 7.3

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CONTENTS

1	INTRODUCTION TO STANDARD DESIGNS AND DETAILS.....	6
1.1	Network Rail's Requirements	6
1.1.1	Delivery Requirements	6
1.1.2	Functional Requirements	6
1.2	Benefits Delivered by the Footbridges Standard Design and Details	7
2	GUIDANCE FOR THE USE OF NETWORK RAIL STANDARD DESIGNS AND DETAILS (SDD)	8
2.1	Approval of Schemes Using Standard Designs and Details	9
2.2	Standard Drawings	9
2.3	Whole Life Costing.....	10
3	BRIDGE ELEMENTS.....	11
3.1	Geometric Limits.....	12
3.2	Sizing for Passenger Flow Requirements	12
3.3	Rain Water Drainage Strategy	12
3.4	Safety and CDM	14
3.5	Environmental	15
3.5.1	Coastal Locations	15
3.5.2	Surrounding surfacing.....	15
4	NON-STATION FOOTBRIDGES & NON-CANOPY STATION FOOTBRIDGES: OPTIONS AVAILABLE WITHIN THE STANDARD DETAILS SUITE	17
4.1	Deck Structure.....	17
4.2	Support Structures	17
4.2.1	Main Span Landing Supports	18
4.2.2	Intermediate Access Supports.....	18
4.3	Access Stairs and Ramps	18
4.3.1	Staircases	19
4.3.2	Ramps.....	19
4.4	Furniture	20
4.4.1	Anti-Vandal Systems	21
4.4.2	OLE Protection	21
4.5	Handrails and balustrades	22
4.5.1	Requirement for the Lower Handrail.....	22
4.5.2	Handrails Finishes	22
4.5.3	Clearances.....	22
4.5.4	Balustrades	23

4.6	Drawing Section	24
5	GEOMETRY CONFIGURATION	26
5.1	Clearances	26
5.1.1	Horizontal and Vertical Clearances	26
5.1.2	Vertical Clearances	26
5.1.3	Platform Edge Clearances	27
5.2	Setting the Geometry	27
6	SPECIFIC DESIGN RESTRICTIONS	28
6.1	Superstructure Restrictions	28
6.2	Substructure Restrictions	28
6.2.1	CHS Supports	28
6.2.2	Trestle Supports	28
6.2.3	Expansion Joints	29
6.3	Access Restrictions	29
6.3.1	Staircases	29
6.3.2	Ramps	30
6.3.3	Cycle ramps or troughs	31
6.4	Bolted Connections	31
7	DESIGN ASSUMPTIONS	32
7.1	Structural Models	32
7.2	Loading	32
7.2.1	Dead Load	32
7.2.2	Live Load	32
7.2.3	Accidental Load	32
7.2.4	Wind Load	32
7.2.5	Thermal Load	33
7.2.6	Settlement	33
7.3	Foundation Design	33
7.4	Fabrication	35
7.5	Equality Act	35
8	NON-CANOPY STATION ENHANCEMENTS	36
8.1	Lighting	36
8.2	Cross ducting	39
8.3	Lifts	41
8.4	Bonding	41
8.5	Operation and Maintenance Manual and Hand Back	41

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9	SPECIFICATION	42
10	INSTALLATION GUIDANCE	43
10.1	Installation Sequence	43
11	16M EUROCODE SDD FOR SHORT SPAN FOOTBRIDGES WITH LIMITATIONS TO EFFECT ECONOMY	44
ANNEX 1	SCHEDULE OF STANDARD DRAWINGS	45
ANNEX 2	L111004/551 COMPARATIVE ANALYSIS OF WIND LOAD DESIGN TO BD37/01 AND BS EN 1991-1-4	48
ANNEX 3	NETWORK RAIL SPECIFICATION – SERIES 1800 STRUCTURAL STEELWORK	49
ANNEX 4	NETWORK RAIL SPECIFICATION GUIDE – SERIES 1800 STRUCTURAL STEELWORK.....	50
ANNEX 5	16M EUROCODE SDD FOR SHORT SPAN FOOTBRIDGES WITH LIMITATIONS TO EFFECT ECONOMY	51

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 objective, 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 one main area that derives from these issues:

- Ensuring that the design meets Network Rail's requirements

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 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 developed 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 shall give warning, and alternative load paths shall be provided for potential local failures.
- No hidden details: All main structural elements shall 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 footbridges have been designed to cater for a range of positions of the structure gauge allowing their wide use.
- Safe working environment: The bridges have been designed to minimise the risk to people on or about the bridge.

These functional requirements are requirements of Network Rail standard NR/L3/CIV/020. This standard has been used and the requirements therein met in developing the standard designs and details.

A library of standard designs and details for non-station and non-canopy-station footbridges that meet these requirements 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 the suite of standard designs and details.
- Instruction on configuring a design using the standard designs and details.
- Specific design restrictions and design assumptions.
- Advice on circumstances when the standard designs and details may not be used.
- 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.

The standard designs and the advice within this document are in accordance with the Department for Transport “Accessible Train Station Design for Disabled People: A Code of Practice” except where noted in this document. Although it is not necessary for non-station footbridges to comply with this advice, it has been assumed as best practice. Sites are all unique and it is by preparing an access statement that issues surrounding accessibility can be duly considered and an appropriate scheme delivered.

1.2 Benefits Delivered by the Footbridges Standard Design and Details

The Footbridges Standard Design and Details have been developed to improve time and cost efficiencies of replacing existing footbridges and level crossings. This is required as part of Network Rail’s on-going maintenance and improvements works.

In all cases the specific scheme designer shall carry out a risk assessment to ensure appropriate applicability and suitability of the Standard Design and Details to the site.

2 GUIDANCE FOR THE USE OF NETWORK RAIL STANDARD DESIGNS AND DETAILS (SDD)

This manual describes the use of the standard designs and details for non-station and non-canopy-station footbridge. It is intended to be read in conjunction with the set of standard drawings listed in Annex 1 and aid the designer in producing an individual bridge design using this standard, or in comparing these standard designs and details with other solutions.

The suite of standard design and details drawings represents typical standard bridge configurations for single span structures with up to 28m between centers of supports. The numerous combinations of site constraints across the country means that span limitations may be required depending on the wind loading at a particular location. Scheme Designers must therefore either demonstrate that a standard design can be applied directly or adapted accordingly to suit a specific site. This Technical User Manual defines the process by which this is achieved.

A separate design has been developed for a maximum span up to 16m and with limited wind forces. Refer to section 11 for further details.

The flowchart in Figure 1 demonstrates the use of the technical user manual and standard drawings. Scheme Designers are required to analyse the constraints and requirements that exist for a specific project site. This Designer output and the series of standard drawings can be combined to produce the final solution.

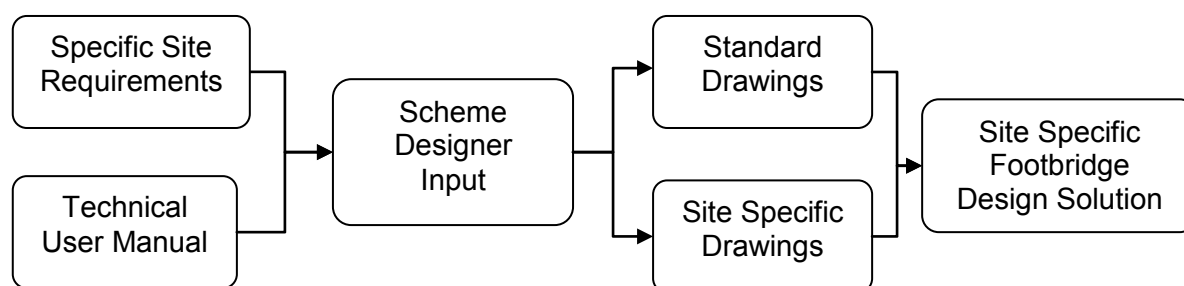


Figure 1 – Flowchart to show the use of Network Rail’s Non-Station Footbridge Standard Design and Details.

The designer is required to determine the bridge layout and produce scheme specific general arrangement drawings. A list of the standard drawings used to define the required works shall be included on the site specific general arrangement drawing.

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

2.1 Approval of Schemes Using Standard Designs and Details

The standard configuration design and details for footbridges have been submitted and approved by Network Rail at both Form A and Form B (including a Category II Check) stages of the Network Rail approvals process in accordance with NR/SP/CIV/003.

The following Network Rail documents form part of the design approval process:

- NR-CIV-SD-FORMA-400 - Network Rail Form A document for the 400 Series signed on 17th September 2013 with DRN.
- NR-CIV-SD-FORMA-700 - Network Rail Form A document for the 700 Series signed on 20th October 2013 with DRN.
- NR-CIV-SD-FORMB-400 - Network Rail Form B document for the 400 Series signed on 5th May 2015 with DRN.
- NR-CIV-SD-FORMB-700 - Network Rail Form B document for the 700 Series signed on 22nd April 2015 with DRN.

In addition see Section 11 for information on Standard Designs and Details for 16m footbridges.

The Scheme Designer will need to produce a scheme specific F001, F002 and F003 in accordance with NR/L2/CIV/003 Issue 4 for the site under consideration.

Technical design requirements for BS EN 1990 have been included with the Form B documents mentioned above.

This Standard Designs and Details shall be used in accordance with NR/L3/CIV/151.

2.2 Standard Drawings

A Suite of Standard Drawings has been produced as part of the Footbridges SDD. A full list is included in Annex 1 of this document. The drawings can be split into categories as shown in Table 1.

It is intended that only those standard drawings relevant to the specific contract are issued to the contractor as part of the contract drawings, together with general arrangement and steelwork drawings for the specific bridge scheme.

The NR/CIV/SD/400 series drawings give the non-station footbridge Standard Design and Details. These can be enhanced for use in non-canopy stations using the NR/CIV/SD/700 series drawings which provide drainage, lighting and the lift connection details, see Section 8.

Table 1 - Standard drawing categories.

Drawing Series	Element	Drawing Type
NR/CIV/SD/400 - 408	Notes & general layout	General
NR/CIV/SD/410 - 413	Support elements	Steelwork details
NR/CIV/SD/420 - 429	Staircase elements	Steelwork details
NR/CIV/SD/430 - 434	Main span elements	Steelwork details
NR/CIV/SD/440 - 448	Ramp elements	Steelwork details
NR/CIV/SD/450 - 451	Truss staircase elements	Steelwork details
NR/CIV/SD/700	Notes	General
NR/CIV/SD/710 - 718	Footbridge	CHS support
NR/CIV/SD/730 - 737	Footbridge	Trestle support
NR/CIV/SD/750 - 757	Footbridge	Lighting details

The standard drawings are not intended as fabrication drawings and fabricators shall produce accurate site specific drawings. Most views will therefore need adjustment to the exact dimensions chosen for the particular bridge. Note that the standard drawings shall not be redrawn or modified in any way and the required changes shall be shown on separate drawings.

When using the Suite of Standard Drawings it is the Scheme Designer's responsibility to:

- Use the general arrangement and steelwork drawings to produce the layout drawings for the site specific footbridge.
- Determine the required span whilst ensuring that the support structure (which includes the stair stringer and span support landing) is at least 4.5m from the nearing running rail to the face of the stringer to mitigate the need for accidental collision loading, unless other means of protection against collision loads are employed, noting that the Standard Details are not designed to accommodate collision loading.
- Determine the required headroom clearance giving consideration to any overhead line equipment.
- Determine the layout of the stairs and ramps (if used).
- Determine the required heights for the main span and stair/ramp supports.
- Produce site specific drawings general arrangement and steelwork drawings using the standard design and details.

2.3 Whole Life Costing

Designs shall be supported by whole life costing, which is mandated on all schemes to ensure design decisions lead to the best whole life cost for Network rail. This principle applies to all aspects of design.

3 BRIDGE ELEMENTS

The standard designs and details have been divided into the following four categories:

- Main span This comprises the bridge deck.
- Supports This comprises supports for the deck, stairs and ramps including holding down details. Note that foundations are not included in the suite of standard designs and details.
- Staircase This comprises staircases.
- Ramps This comprises ramps.

Within the suite of standard designs and details are different options for each of the above to accommodate a range of site requirements (refer to section 4 & 5). A separate set of drawings are being developed for footbridges up to 16m span. Please refer to Annex 5 for guidance on short span footbridges.

The staircases are connected directly to the supports and will always be present. The design has been developed based upon the stairs providing propping to the main span supports. The top of the staircase section incorporates the main span landing. If ramps or lifts are present they will be connected to the main span landing edge, opposite the staircase access. The main span is connected to the trackside edge of the main span landing. The staircases with and without ramps/lift will be stable on the supports without the main span present i.e. during initial construction or deck removal.

The stairs and ramps must always be installed perpendicular to the span.

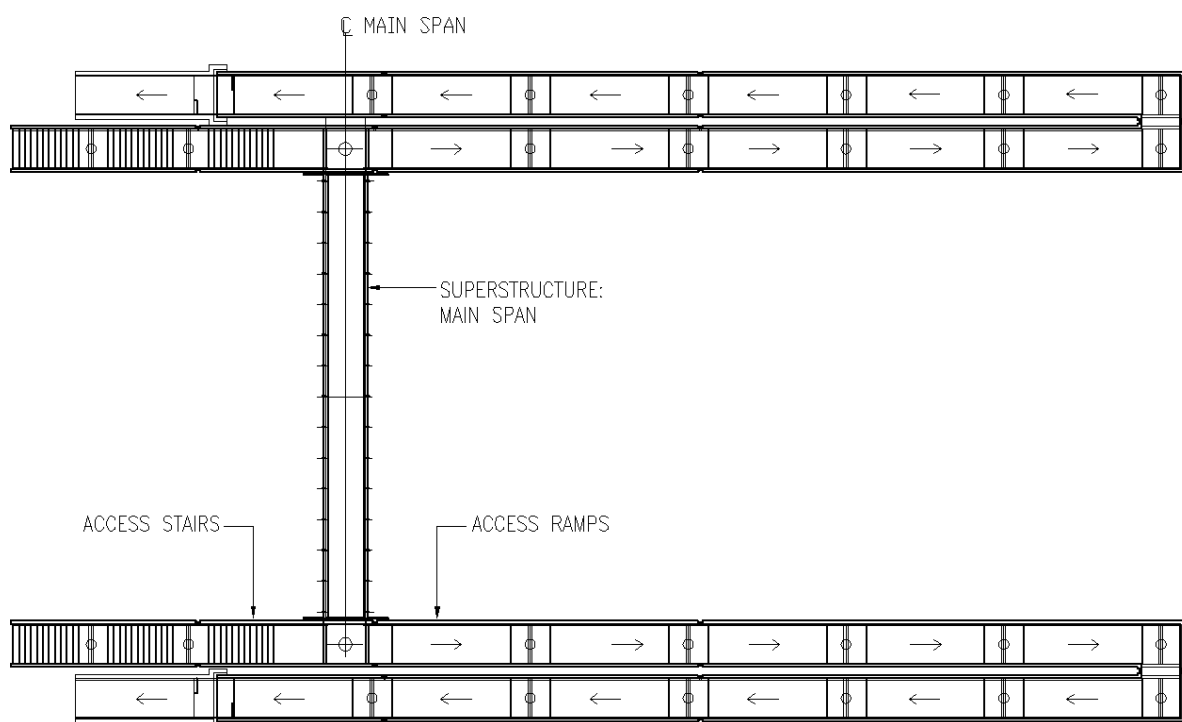


Figure 2 – Footbridge elements

3.1 Geometric Limits

The structure has been designed for a maximum span of 28m measured between the centre of the stair landings and a maximum vertical clearance of 6.3m from the top of the running rail to the bridge soffit. The maximum allowable span is limited depending on the wind pressure at each specific site. See Section 7.2.4 for details.

The table below provide height limitations on the supports (measured from top of foundation to top of column) depending upon the section used and location to cater for different surrounding topography.

Table 2 – Height limitations on support types.

Location	Section	Maximum Height
Main span landing	150x12.5 SHS	7.7m
Stringer stairs and ramps	250x150x12.5 RHS	7.2m
Ramps only	250x100x10 RHS	2.0m
Main span landing	660x20 CHS	8.2m
Stringer stairs and ramps	508x16 CHS	6.5m

3.2 Sizing for Passenger Flow Requirements

The required clear width of a bridge is dependent on the clear width of the stairs leading onto it. This in turn is dependent on the number of people alighting and boarding a train or trains.

The standard design footbridge is designed to allow 72 people per minute to walk in one direction to access the main span using one staircase (2m between handrails) or if there is a two-way flow it will allow 58 people per minute to move across the structure.

The flow rate on the footbridge is however 56 people per minute due to the edge effect of 30cm both sides, reducing the effective width of the bridge to 140cm.

Station Capacity Assessment Guidance (2014) shall be used to work out the size of both the stairs and the bridge as appropriate to the Client's Requirements for the structure.

The Station Capacity Team in Group Strategy can be contacted for further assistance at stationcapacity@networkrail.co.uk.

3.3 Rain Water Drainage Strategy

The scheme designer shall prepare a suitable rain water disposal system as fits the design requirements. The standard design drawings indicate an outline system only.

The bridges surface water run-off is achieved through nominal falls to all decks and a weep-hole system discharging into spitter pipes (Drg No. 400 & 445). Cross falls on the deck, ramp and landings are 25mm from centreline. Typical longitudinal falls on landings are 30mm. The spitter pipes serve to mitigate steel corrosion by discharging water off from the structure. This drainage approach is seen as sufficient for typical non-station locations.

Where a drainage system is installed the spitter pipes shall be reduced in overall length as their purpose has changed to that of a 'connector'. A reduced drop is recommended so that the connecting pipe-work is hung closer to the adjacent structural soffit.

Where sites require controlled water run-off, such as at station locations or where water flowing from the main span, stair and ramp spitter pipes will present problems by encouraging ponding on station platforms, a surface water drainage scheme is required.

All designs utilise similar spitter pipe systems. The spitter pipes are 'inserted' into the above ground rain water disposal system, directly into an open pipe or hopper (with leaf grill if required). Spitter pipe type and drainage system shall be adjusted so they are compatible. This is because should a total block-up of an otherwise sealed system occur the design allows water to discharge at this open connection and so eliminate potential flooding of the bridge decking. The scheme designer shall provide means to prevent hopper from filling with detritus.

A partial rain water drainage system may be determined appropriate. In this case only the ramps / landings / deck outlets over the public platforms are connected into a rain water disposal system that combine various drainage points into convenient groups that join into a pipe that in-turn acts as a combined spitter or suitable outlet. This must discharge away from the public realm in a suitable location, ideally into a drain gully or channel, or the far back of the platform / rear boundary / fence where water cannot flow back. Drainage not to flow into cess and cause wet beds.

A double flight staircase with no intermediate support cannot be used when a managed drainage system is required.

The standard drainage design uses galvanised mild steel pipe for robustness. However an aluminium system is acceptable where theft and impact damage can be considered as low risk. If selected the aluminium is to be marine grade to BS 6063 Type T5 hardened due to increased 50 years life expectancy, with an internal spigot joint between pipes. The tube thicknesses shall be reviewed by the designer to limit wear and tear indentation, as well as to achieve general robustness, by selecting a wall profile greater than 1.6mm. Additional fixings may also be considered where public access is possible at reduced centres of around 1 metre.

Where no colour preference is required the pipe-work default standard design finish is either galvanised or powder coated to RAL 9006 (grey). An aluminium mill (uncoated) natural finish shall not be used (as colour variation between welded blackening / whitening and bear pipe finishes is common). The use of powder coated parts achieves a finished uniformity and reduces any theft value as scrap due to having to burn off the coatings. Electrolytic corrosion shall be prevented through suitable detailing as appropriate.

The drainage design shall be completed prior to fabrication so that the drainage pipe supporting brackets can be 'shop' welded to the structure and painted off site. The brackets are included to prevent direct drilling into the footbridge structure and its

hollow sections. The standard details show typical drainage routes from the spitter pipes to ground level and typical fixing details.

Drainage system design shall be fully maintainable using rods with suitable access points incorporated.

At ground level all drainage pipes shall enter a reducer into Q trap bottle gully inspection chamber or gully with secure gully grill.

Drainage shall be provided with all access points necessary to assure maintenance.

The construction may affect the existing platform routes and platform surface falls. Renewed platform finishes may be required to enable adjustments to platform falls. Open discharge at the foot of down pipes is not permitted onto accessible platform areas. For details of standard drainage systems refer to the Operational Property Design & Construction Handbook (OPDCH). Where below ground systems are being designed suitable interceptors are to be selected. All drainage shall comply with OPDCH requirements.

3.4 Safety and CDM

The general (non-site specific) risks associated with the bridge design, construction and operation are listed on drawing 400 and 700. In addition there may be others arising from site-specific considerations, such as

- Presence of Overhead Line Equipment (OLE) or vulnerable services.
- Ground conditions.
- Access to site and clearance.
- Protection of Cable Routes and track
- Signal sighting.
- Gauge requirements.
- Land Requirements & Party walls.
- Working Hours and any restrictions in Noise/Light, etc.
- Ecological species and any other environmental issues.
- Design concept and its construction.
- Independent third party Services.
- Access for all requirements.
- Lighting, Emergency lighting and NWR Services.
- Pedestrian flow requirements.
- Possession requirements and Electrification possession requirements.
- Footpath closures and alternative footbridges.
- Environment and the most suitable materials, including whole life costing.
- Inspection, Testing and commissioning provisional specifications.
- Temporary Works Requirements.
- Temporary Lighting Requirements.
- Crainage areas.
- Signage and labelling to be moved and /or provided.
- Lighting glare to drivers
- Surfacing requirements surrounding footbridge location
- Project or programme specific needs and desires

- Entry into service requirements
- Station change requirements
- Network Rail Standards and Group Standards requirements
- Local authority, Highway and Planning requirements, e.g. compliance with BD29/04, lighting or aesthetics requirements
- T&V requirements to be based on site specific assessments

The scheme designer shall prepare a risk assessment accounting for the agreed way forward on the specific design to ensure the Eurocode TUM Design is flexible to accommodate site specific reviews on a case by case basis, in regards to such matters as ducting selection and the approach to artificial lighting, etc.

3.5 Environmental

Environmental issues can only be determined on a site by site basis. However the following considerations must be taken into account for every installation;

- The effect that any additional land requirements for the ramp may have on locality,
- Effects on the environment, particularly any watercourses, that may arise from renewal of the protection scheme and whether these may be reduced or eliminated during the design phase,
- The aesthetic effect of the bridge's presence on the surrounding area and whether requirements for bridge colouration or other details exist as a result.

A table shall be submitted to list the issues and resulting solutions to find the best design for that location.

3.5.1 Coastal Locations

Where appropriate to the site's environmental conditions the entire footbridge design and its finishes should be adjusted to pro-long the whole life value of the asset. Consideration could be given to section thickness increase, FRP/plastic materials, sacrificial protection plates, waterproofing & corrosion prevention systems. The infill panel vertical RHS may be up-graded to a solid section or the use of other infill systems that do not corrode shall be specified.

Galvanising shall be to recommendations contained within BS EN ISO 14713 and guidance from Galvanizers Association.

3.5.2 Surrounding surfacing

All foot areas off the footbridge connecting back to walkways or platform shall be specified, i.e. Tactile's renewal of tarmac, pavers, slabs, etc. for at least five metres around structure. Also under trestle area and replacement platform surfaces. These surfaces shall not have a slip resistance value in dry or wet less than SRV 45. Platform surfaces within 1.25m of the platform edge shall have a SRV of 55 or greater.

All foot surfaces of the footbridge shall be specified for agreement with Network Rail. The slip resistance of all stepping components of the footbridge and any replacement platform surfaces shall have a minimum slip resistance value of 55 measured both 'in the dry' and 'in the wet' for '4S' grade rubber, in accordance with the PENDULUM floor friction test as specified in BS EN 13036-4 Method for

measurement of slip/skid resistance of a surface – The pendulum test. The slip resistance value shall be capable of being maintained over the life of the system, taking account of the likely wear and weathering effects both natural and due to any cleaning processes, such as chemical cleaning agents and polishing.