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T HR CI 12030 ST

Standard

Overbridges and Footbridges

Version 1.0

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Standard governance

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Document history

Version	Summary of Changes
1.0	First issue

For queries regarding this document, please email the ASA at standards@transport.nsw.gov.au or visit www.asa.transport.nsw.gov.au

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Preface

The Asset Standards Authority (ASA) is an independent unit within Transport for NSW (TfNSW) and is the network design and standards authority for defined NSW transport assets.

The ASA is responsible for developing engineering governance frameworks to support industry delivery in the assurance of design, safety, integrity, construction, and commissioning of transport assets for the whole asset life cycle. In order to achieve this, the ASA effectively discharges obligations as the authority for various technical, process, and planning matters across the asset life cycle.

The ASA collaborates with industry using stakeholder engagement activities to assist in achieving its mission. These activities help align the ASA to broader government expectations of making it clearer, simpler, and more attractive to do business within the NSW transport industry, allowing the supply chain to deliver safe, efficient, and competent transport services.

The ASA develops, maintains, controls, and publishes a suite of standards and other documentation for transport assets of TfNSW. Further, the ASA ensures that these standards are performance-based to create opportunities for innovation and improve access to a broader competitive supply chain.

This standard was developed by the Chief Engineer Rail section of the ASA, reviewed by a committee of TfNSW cluster representatives and approved by the ASA Configuration Control Board.

This standard details the design requirements for overbridges and footbridges on the TfNSW heavy rail network and was developed from RailCorp standard ESC 320 *Overbridges and Footbridges*, Version 2.2.

ESC 320 is withdrawn with the publication of this standard.

This standard is a first issue.

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Foreword

This standard is intended to be used by competent personnel engaged in the provision of services relating to rail infrastructure. Compliance with the requirements in this standard will not, by itself, be sufficient to ensure that satisfactory outcomes will be produced. Personnel providing services based on the standard need to bring appropriate expertise to the matters under consideration.

In addition to the requirements of this standard, asset decisions shall take into account the life cycle cost considerations specified in T MU AM 01001 ST *Life Cycle Costing.*

If, when using the standard, it is considered that the intent of stated requirements is not clear, a clarification should be sought from the ASA.

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1. Introduction

An overbridge is a bridge carrying vehicular traffic over the track. Overbridges may include provisions for pedestrians and cyclists.

A footbridge is a bridge over the track that carries pedestrian traffic only. Footbridges may be standalone structures at stations; standalone structures between stations; or, when combined with an overhead booking office or retail outlets, can be part of station concourses.

2. Purpose

This standard details the design, refurbishment, decommissioning and disposal requirements for overbridges and footbridges on the Transport for New South Wales (TfNSW) heavy rail network.

This document also provides guidance on compliance of refurbished works and aesthetic considerations for overbridges and footbridges.

2.1. Scope

This standard does not cover the load rating of overbridges and footbridges. This work shall be undertaken in accordance with AS 5100.7 *Bridge design – Part 7: Rating of existing bridges.*

2.2. Application

This standard applies to the design of new overbridges and footbridges and the design of refurbishment works for existing overbridges and footbridges on the TfNSW heavy rail network.

This standard is intended to be used by competent personnel engaged in the provision of services relating to rail infrastructure. Compliance with the requirements in this standard will not, by itself, be sufficient to ensure that satisfactory outcomes will be produced. Personnel providing services based on the standard need to bring appropriate expertise to the matters under consideration.

If, when using the standard, it is found that the intent of stated requirements is not clear, a clarification should be sought from the Asset Standards Authority (ASA).

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3. Reference documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

Australian standards

AS 1085.1 Railway track material – Part 1: Steel rails

AS 1744 Forms of letters and numerals for road signs (known as Standard alphabets for road signs)

AS 1530.4 Methods for fire tests on building materials, components and structures – Part 4: Fire-resistance tests for elements of construction

AS 1906.1 Retroreflective materials and devices for road traffic control purposes – Retroreflective materials

AS 2832.5 Cathodic protection of metals – Part 5: Steel in concrete structures

AS 5100 Bridge design

AS 5100.1 Bridge design – Part 1: Scope and general principles

AS 5100.2 Bridge design – Part 2: Design loads

AS 5100.7 Bridge design – Part 7: Rating of existing bridges

AS/NZS 1734 Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate

AS/NZS 3845 Road safety barrier systems

Transport for NSW standards

EP 10 01 00 06 SP HV Aerial Line Standards for Design and Construction

ESB 000 Introduction

ESB 001 Station Context and Processes

ESB 002 Design Principles

ESB 003 Station Functional Spaces

ESB 004 Station Services and Systems

ESC 100 Civil Technical Maintenance Plan

ESC 302 Structures Defect Limits

ESC 215 Transit Space

ESC 220 Rail and Rail Joints

ESC 350 Platforms and Retaining Walls

ESC 420 Track Drainage

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ESG 100.17 Signal Design Principles Track Circuits

SPC 301 Structures Construction

T HR EL 08001 ST Safety Screens and Barriers for 1500 V OHW Equipment

T HR EL 20003 ST Underground installation configurations for high voltage and 1500 V dc cables

T MU AM 01001 ST Life Cycle Costing

T MU AM 01003 ST Development of Technical Maintenance Plans

TMD 0001 CAD and drafting manual – All design areas – Section 1 and Section 2

TMD 0001 CAD and drafting manual - Civil design – Section 3

TS 20001 System Safety Standard for New or Altered Assets

30-ST-164/4.0 TfNSW Enterprise Risk Management Standard (available on request from standards@transport.nsw.gov.au)

TN 016: 2015 Earthing and Bonding Requirements for Overbridges and Footbridges

Transport for NSW standard drawings

CV 0179048 Guard rails – Installation of guard rails ballast top underbridge – General Arrangement

CV 0179050 Guard rails – Installation of guard rails ballast top underbridge – Details of guard rails on concrete sleepers

CV 0179051 Guard rails – Installation of guard rails ballast top and transom top underbridges – Detail of tapered nose section

CV 0282111 Standard – All lines – Danger Sign “No Safe Place” – General Arrangement

CV 0301159 Standard – All lines – Handhold Devices – General Arrangement

CV 0558906 Typical Details – All Lines – Combined ALT 1 & Guard Rail Plate – Details

Legislation

Environmental Planning and Assessment Act 1979 (NSW)

Heritage Act 1977 (NSW)

Other reference documents

Australian Paint Approval Scheme, Specification 1441/1 - Permanent exterior clear graffiti barrier

Austroads, Guide to road design

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Department of Planning and Environment July 2007, Transport Corridor Outdoor Advertising and Signage Guidelines – Assessing Development Applications under SEPP 64, publication number DP 07-033

Office of Environment and Heritage January 2005, State Agency Heritage Guide – Management of Heritage Assets by NSW Government Agencies, publication number HO05/01

RailCorp February 2011, Structures over track risk model, publication number 220512-R-003

Roads and Maritimes Services July 2012, Bridge Aesthetics – Design guidelines to improve the appearance of bridges in NSW

Roads and Maritime Services, Bridge Technical Directions

Roads and Maritime Services, Specification D&C B345 – Supply of Bridge Nameplates

4. Terms and definitions

The following terms and definitions apply in this document:

AEO Authorised Engineering Organisation

APAS Australian Paint Approval Scheme

ASA Asset Standards Authority

OHW overhead wiring

RMS Roads and Maritime Services

SFAIRP so far as is reasonably practical

TfNSW Transport for New South Wales

5. Safety requirements

The design of overbridges and footbridges shall take into account safety considerations for construction, operational, maintenance and decommissioning workers; and of the potential users of the structure.

The Authorised Engineering Organisation (AEO) shall establish and implement a design process system that manages safety assurance across the full life cycle of the structure. The design process system shall be developed with reference to TS 20001 *System Safety Standard for New or Altered Assets.*

The design of overbridges and footbridges shall provide safe access for inspection and maintenance in accordance with AS 5100 *Bridge design*. This may include items such as access steps, ladders, cages, walkways and fixing points

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6. Environmental and heritage requirements

The design of overbridges and footbridges, including the refurbishment of existing structures, shall consider environmental impacts and sustainability opportunities during investigation, design, construction and operational activities.

The design shall consider sustainability over the life cycle of the asset. Considerations relating to overbridges and footbridges include the following:

- embodied energy in construction materials
- protection or enhancement of biodiversity
- stormwater management
- noise and vibration particularly during construction
- traffic effects particularly during construction

Environment and heritage management is governed by the *Environmental Planning and Assessment Act 1979* (NSW) and the *Heritage Act 1977* (NSW).The Environmental Planning and Assessment Act requires that environmental impacts resulting from development be appropriately assessed. This includes impacts on heritage items. The Heritage Act is the relevant legislation designed to protect, conserve and manage environmental heritage, including items of archaeological significance. When changes are proposed for items listed on the State Heritage Register, the provisions of the Heritage Act shall be met. For heritage items listed on the Section 170 State agency heritage register, the principles and relevant guidelines contained in the Office of Environment and Heritage *State Agency Heritage Guide – Management of Heritage Assets by NSW Government Agencies* shall be followed.

Maintenance and designed changes to listed overbridges and footbridges shall be undertaken in a manner that respects and maintains their heritage significance. Such work shall result in minimal adverse visual and physical heritage impacts, not only upon the bridges themselves, but also on their setting and broader landscape context.

All relevant environmental factors, including heritage significance, should be considered at a sufficiently early stage of a project to be satisfactorily addressed in concept designs. When bridges need to be modified, anticipated maintenance requirements for maintaining and conserving heritage fabric shall be taken into proper account at all design stages. Alternative approaches to conservation, including appropriate means of protecting significant fabric from damage and vandalism, may be required for bridges (and remnant sections of bridges) that are no longer being used.

Whilst rail heritage listings typically comprise a station group or precinct, a number of overbridges and footbridges are individually listed as individual items. In station precincts, overhead booking offices are often located adjacent to, or structurally integrated with

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overbridges or footbridges (common to many early steel girder footbridges), and so the maintenance of these related elements should be considered sympathetically.

7. Construction

The design documentation shall identify standards for construction, including construction methods, processes and materials.

Overbridges and footbridges shall be constructed in accordance with SPC 301 *Structures Construction*.

The design documentation shall reflect this requirement and shall include any project specific requirements necessary for completeness of the technical specifications.

The design shall take into account construction constraints, particularly construction activities during live road and rail operating conditions as well as any restrictions associated with construction during track possession.

8. Maintenance

The design shall provide ease of access to, and sufficient clearance around components for inspection and maintenance activities.

The design engineer shall carefully select components, materials and finishes that will minimise maintenance during the life of the structure.

Maintenance requirements shall be specified, in the form of a technical maintenance plan, in the design documentation of the structure. The requirements shall include examination tasks and frequencies, damage limits and repair standards. In most cases, ESC 100 *Civil Technical Maintenance Plan* and ESC 302 *Defect Limits* will apply. However, it may be necessary to document site specific maintenance requirements.

The requirements and high level processes for the development of technical maintenance plans are detailed in T MU AM 01003 ST *Development of Technical Maintenance Plans.*

9. Decommissioning or disposal

Decommissioning is the final process of withdrawing an asset from active service on the network.

Disposal is the process of removing an asset from the network. For example demolition of an overbridge followed by removal and recycling.

The decommissioning or disposal of an asset is the final stage of the asset life cycle. Proper planning of this part of the life cycle is an integral part of the strategic life cycle process.

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The process to be undertaken for the disposal of an overbridge or footbridge shall be as follows:

i A report shall be produced to confirm that the asset is surplus to the requirements of the rail network or it is life expired.

ii The report shall identify the benefits including financial and costs arising from the proposed decommissioning or disposal.

iii The report shall confirm stakeholder engagement regarding the proposed action. Such engagement shall include, but not be limited to heritage, council and environmental body consultation.

iv The means of decommissioning or disposal shall be a risk based decision carried out in accordance with the TfNSW safety management system. Refer to 30-ST-164 *TfNSW Enterprise Risk Management Standard* for requirements regarding the mitigation of risk SFAIRP.

v The report shall include a decommissioning or disposal plan for implementation.

Following decommissioning or disposal, the asset database shall be updated to reflect network changes.

95% of construction and demolition waste by weight of the decommissioned asset shall be diverted from landfill.

10. Nameplates and plaques

Nameplates shall be provided on all new overbridges and footbridges and on bridges that undergo major refurbishment works.

All details for nameplates shall comply with Roads and Maritime Services specification B345 *Supply of Bridge Nameplates* except for the legend and location details.

The following legend and location details provided shall be used instead:

- the nameplate shall indicate the kilometrage of the bridge, the name of the constructing authority (for example TfNSW) and the year of construction
- the nameplate shall be securely attached to a suitable location on the Down Sydney side of the bridge (for example the bridge kerb or the end-post of the balustrade)

11. Attached advertising signs

Advertising signs shall not be attached to the external faces, that is, facing towards the track of overbridges and footbridges.

Advertising signs may be attached to the road or pedestrian traffic faces of overbridges and footbridges.

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The design load for advertising signs shall be in accordance with the relevant Australian standards.

The bridge shall be assessed to determine if it has sufficient structural capacity to carry the additional load from the advertising sign.

Fixing details shall be in accordance with the relevant Australian standards and good engineering practice. The advertising signs shall not adversely affect the structural integrity of the bridge. The advertising signs shall only be fixed to existing structural members only when the AEO determines that there will not be an adverse effect on the structure.

Advertising signs shall not create an obstruction that causes water to pond or debris to accumulate anywhere on the overbridge or footbridge. Signs shall not be a factor in the deterioration of the bridge.

Fixings and ladders for the sign shall not infringe the clear walking space of footbridges or pedestrian walkways on overbridges.

Signs and fixings shall not prevent access for inspection and maintenance of the overbridge or footbridge; and this includes the part of the structure immediately behind the sign.

Additional information on advertising signs is in the Department of Planning and Environment publication *Transport Corridor Outdoor Advertising and Signage Guidelines – Assessing Development Applications under SEPP 64*.

12. Design criteria

The design of an overbridge or footbridge shall take into account associated requirements such as service routes; overhead wiring and signalling infrastructure; earthing and bonding; drainage; architectural treatments; and any other site specific requirements.

Where proper design of temporary works requires a detailed knowledge of the structural capacity and structural behaviour of the permanent works component, the detailed design and documentation of the temporary works shall be carried out by the AEO that prepared the permanent works design.

12.1. Configuration

The configuration of overbridges and footbridges shall comprise a clear span between abutments.

Footbridges without abutments shall comprise a clear span between outer piers.

Intermediate piers are permissible when they are located on platforms with the characteristics defined in Section 12.8 of this standard.

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Bridge decks on new structures shall be structurally continuous without gaps or openings in order to prevent debris penetrate the deck within the spans. Where precast beams with gaps are used, the top surface shall comprise a continuous deck slab.

Bridge decks installed in the refurbishment of a bridge (for example, deck replacement) shall be structurally continuous.

12.2. Aesthetics

The final appearance and aesthetic qualities of a bridge shall be considered in the design process. The overall form of a bridge should have a pleasing appearance and should also look appropriate for its specific location.

Designs for bridge structures shall be considered in relation to environmental context. Sensitive contextual design involves being responsive to a particular setting. It is not enough for structures merely to look inoffensive; they should make a positive visual contribution to their surroundings.

Refer to Appendix D for guidance on aesthetic considerations for overbridge and footbridges

12.3. Graffiti

Anti-graffiti paints shall be used on bridges in all areas accessible by the public and in areas within the corridor where the rail infrastructure manager determines that there is a high risk of graffiti. Anti-graffiti coatings shall comply with APAS specification 1441/1 *Permanent exterior graffiti barrier*. Overbridges and footbridges shall not be painted in the safe working colours of red, orange or green.

12.4. Design standards

Overbridges and footbridges shall be designed to AS 5100 and the requirements specified in this engineering standard. Where there is any conflict, the requirements of this standard shall take precedence over AS 5100.

Refer to Section 13 for requirements for the refurbishment of existing overbridges and footbridges.

Overbridges and footbridges located at stations shall also comply with the following TfNSW stations and buildings standards:

- ESB 000 *Introduction*
- ESB 001 *Station Context and Processes*
- ESB 002 *Design Principles*
- ESB 003 *Station Functional Spaces*

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- ESB 004 *Station Services and Systems*

12.5. Roads and Maritime Services Bridge Technical Directions

The design of overbridges and footbridges shall comply with the requirements set out in the relevant Roads and Maritime Services (RMS) Bridge Technical Directions. Where a conflict exists between the requirements of this document and an RMS Bridge Technical Direction, the requirements of this standard shall take precedence.

The RMS Bridge Technical Directions relevant to overbridges and footbridges are listed in Appendix A.

12.6. Design life

The design life of overbridges and footbridges shall be in accordance with AS 5100.

The design life of ancillary structures shall be as specified in this engineering standard, or, if not specified, then other relevant Australian standards.

12.7. Traffic loads

Overbridges shall be designed for the traffic loads specified in AS 5100.

Where an overbridge is on a road used exclusively to provide access along the rail corridor (not a public road), the overbridge may be designed for a minimum design load of T44.

Footbridges shall be designed for the pedestrian traffic loads specified in AS 5100.

Footbridges at stations shall be designed for crowd loading as specified in AS 5100.

12.8. Collision loads and protection requirements

The configuration of overbridges and footbridges shall comprise a clear span between abutments.

Footbridges without abutments shall comprise a clear span between outer piers.

Intermediate piers are permissible when they are located on platforms with the characteristics defined in Section 12.8 of this standard.

Overbridges and footbridges shall be designed for protection from collision from railway traffic. The loading and design of collision protection shall comply with the requirements set out in AS 5100.

Piers and columns located adjacent to roadways shall be designed and protected in accordance with the requirements set out in AS 5100.

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Collision loads on support elements specified in Clause 10.4.3 of AS 5100.2 *Bridge design – Part 2: Design loads*, shall not apply to piers and columns located on platforms that present all the following characteristics:

- platforms are earth-filled and designed in accordance with ESC 350 *Platforms and Retaining Walls*
- the transverse location of the face of a pier or column (with respect to the design centreline of track) is in accordance with ESC 215 *Transit Space* (that is, 4.3 m or more from the design centreline of track)
- the longitudinal distance of a pier or column (with respect to track) is more than 20 m from the end of a ramped platform (excluding the length of the ramp); or, is more than 2.6 m from the end of a vertical (non-ramped) platform

All piers and columns, including those on platforms as described above, shall be designed for the minimum collision load specified in Clause 10.4.4 of AS 5100.2. Platforms shall not be assumed to provide a degree of protection to permit reduction of this collision load.

12.8.1. Lift structures

If a lift structure supports an overbridge or a footbridge, it shall be treated as a pier or column and the requirements for collision protection provided in this standard applies.

For lift structures that do not provide support for bridge structures refer to the appropriate TfNSW stations and buildings standard.

12.8.2. Temporary bridges

Temporary bridges are bridges that are intended to be in service for no more than 12 months. Any bridge intended to be in service for more than 12 months shall be considered a permanent bridge and shall be designed in accordance with the requirements of this standard.

All proposed temporary bridges shall undergo a risk assessment to ascertain whether any relaxation to the load requirements of AS 5100 can be made. In any case, the loading shall not be less than that specified in Clause 10.4.4 of AS 5100.2.

The risk assessment shall assess risk against the risk criteria defined in 30-ST-164 *TfNSW Enterprise Risk Management Standard*. The risk assessment shall be site specific and shall consider the following:

- site condition, including cuttings and embankments
- derailment history
- type of bridge; that is, the potential for collapse and damage to trains
- derailment risk at the location

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- track components in the direction of travel, for example, catchpoints, turnouts, slips, diamonds or scissor crossovers
- track geometry; that is, straight or curved track
- track speed at the location
- type of rolling stock
- future usage and growth in patronage

The risk assessment shall also consider any other relevant site specific criteria.

Refer to AS 5100.2 Supplement 1 for further guidance.

The results of the risk assessment will determine the category of collision loading in AS 5100 that is to be applied to a support. The risk ranking determined from the risk analysis shall be equated to a loading requirement from AS 5100 and is shown in Table 1 below:

Table 1 – Collision loading requirements

TERM risk matrix	AS 5100 collision loading requirements
A	All requirements of AS 5100.2 clause 10.4.3, clause 10.4.4, clause 10.4.5 and clause 10.4.6.
B	AS 5100.2 clause 10.4.3 (using loading for between 10 m and 20 m from centreline of track), clause 10.4.4, clause 10.4.5 and clause 10.4.6.
C	AS 5100.2 clause 10.4.4, clause 10.4.5 and clause 10.4.6.
D	AS 5100.2 clause 10.4.4 and clause 10.4.6.

The use of lower order protection devices such as earth mounds, gabions, and guard rails may be used in the risk assessment to reduce the risk ranking if approval is obtained from the Lead Civil Engineer, ASA.

12.9. Earthquake effects

The bridge classification of an overbridge shall be Type III; that is, essential to post-earthquake recovery, to ensure that main lines are not blocked.

Overbridges over sidings may be Type II subject to the approval of the road authority.

The bridge classification of a footbridge shall be Type II.

12.10. Fire effects for footbridges

The fire effects apply to the structural elements of the footbridge above the tracks excluding other spans, stepways and ramps not above the track.

Footbridges shall have a fire resistance level of 60/-/- and the time-temperature curves for the fire shall be taken from AS 1530.4 for cellulose materials.

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12.11. Bearings and deck joints

The design of bearings, joints and adjacent structural elements shall incorporate adequate access for inspection, maintenance and replacement of bearings and joints.

There shall be adequate clearance to allow for inspection and maintenance activities.

Jacking points for bearing replacement activities shall be provided on the bearing shelf.

12.12. Clearances

Horizontal and vertical clearances for new overbridges and footbridges shall comply with ESC 215.

Horizontal and vertical clearances for new elements on a refurbished overbridge or footbridge shall comply with ESC 215.

The design of overbridges and footbridges shall also provide clearances for safe places as detailed in Section 16 of this standard.

12.13. Abutments and wingwalls

Bridge abutments comprising reinforced soil walls shall have piled sill beams.

Wingwalls within 10 m of the nearest track should be parallel to the rail track. However, they shall not be at an angle of more than 15 degrees to track.

12.14. Earthworks

Earthworks associated with the approaches to overbridges and footbridges shall be designed in accordance with the relevant RMS earthworks specifications.

12.15. Drainage

Drainage of the bridge deck shall be designed in accordance with AS 5100.

The design average recurrence interval shall be 50 years.

The minimum design life of drainage components (including the back of abutment and associated retaining wall elements) shall be 100 years.

The water shall be directed away from platforms and other rail infrastructure and it shall not discharge onto the track or near structure footings.

The drainage system shall be cleanable with a minimum pipe diameter of 150 mm.

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12.16. Stepways

Riser and tread dimensions for footbridge stepways shall be 150 mm and 300 mm respectively.

Stepway risers shall be closed in to prevent visibility from beneath the structure and to prevent items falling through.

12.17. Attachment of overhead wiring

Overhead wiring (OHW) shall not be attached to a bridge unless this is not avoidable due to the width of the bridge or the design of the overhead wiring system.

Approval to attach OHW anchors shall be obtained from the Lead Civil Engineer, ASA.

Where anchors are to be used to attach overhead wiring to a bridge, the electrical requirements shall comply with Technical Note TN 016: 2015 *Earthing and Bonding Requirements for Overbridges and Footbridges*. The anchors shall be stainless steel chemical anchors.

12.18. Cathodic protection

The bridge design shall incorporate provisions for the future installation of cathodic protection in accordance with the requirements set out in AS 2832.5 *Cathodic protection of metals – Part 5: Steel in concrete structures*.

12.19. Bird nesting

Design features such as spikes shall be installed to prevent birds nesting on an overbridge or footbridge.

Bird proof screening shall be provided around bearings.

12.20. Approved materials

Approved construction materials for main structural elements are steel and concrete. Timber materials shall not be used as structural elements in overbridges and footbridges.

Masonry is approved for the refurbishment of existing structures and for cladding of new structures where this is required in special circumstances such as for heritage reasons.

Fibrous asbestos cement deck sheeting shall not be used on new and refurbished footbridges.

Fibre composite and engineered timber products may be used for elements subject to the approval of the Lead Civil Engineer, ASA.

Compressed fibre cement sheeting may be used for the refurbishment of footbridge decks subject the approval of the Lead Civil Engineer, ASA.

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If any products specified in the design documentation can reasonably be deemed to be new or infrequently used, these shall be identified by the design engineer and referred to the Lead Civil Engineer, ASA for approval. The design engineer shall ensure that the manufacturer, constructor, or maintainer of the product understands any special requirements or practices relating to the product prior to release of the design documentation, which shall include documentation of these special requirements.

12.21. Formwork

Permanent formwork located above 1500 V dc OHW equipment shall comprise a non-corrosive and non-conductive material, in order to eliminate the potential safety risk of deterioration and subsequent contact with the equipment.

Steel decking shall not be used on the span above electrified track or above track that may be electrified during the expected lifespan of the structure.

Acceptable products for permanent formwork above electrified tracks include non-conductive material such as fibreglass.

12.22. Provision for services

The design of overbridges and footbridges shall accommodate services owned by TfNSW and external utilities organisations. Services owned by TfNSW can relate to signalling and communications, bridge lighting and high voltage and low voltage systems. Utilities by other organisations can include telephone, water supply, sewer lines and power and gas.

The designer shall consult the relevant authorities and shall provide special ducts for current services and, where appropriate, future services. When required, services shall be segregated, for example, power and signalling. Segregation requirements for high voltage cables shall be specified. Segregation requirements for high voltage cables are nominated in T HR EL 20003 ST *Underground installation configurations for high voltage and 1500 V dc cables*.

The location and fixing of such service ducts shall facilitate access to services for maintenance activities without the interruption of rail operations. The location and fixing of service ducts shall not obstruct access to the main structure for inspection and maintenance activities.

The preferred placement is that service ducts are housed within the structure, for example under footways, rather than having exposed service ducts.

12.23. Traffic barriers

A traffic barrier is a fence or wall along the edge of an overbridge or footbridge, installed to prevent road vehicles, cyclists and pedestrians from falling over the edge of the bridge

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Traffic barriers for overbridges shall be designed in accordance with the requirements set out in AS 5100. Traffic barriers for overbridges above the rail corridor shall be at least medium performance level and shall be subject to a risk assessment to determine whether a special performance level is required.

Approach barriers to overbridges shall also comply with Austroads *Guide to road design* and AS/NZS 3845 *Road safety barrier systems*. This shall include the transition from a rigid bridge barrier to an approach barrier or flexible barrier type on the roadway.

The minimum height of pedestrian barriers and balustrades shall be 1200 mm. Where an overbridge or footbridge provides access to a railway station, the relevant configuration requirements set out in the following standards shall be incorporated into the design:

- ESB 000
- ESB 001
- ESB 002
- ESB 003
- ESB 004

12.24. Safety screens

Safety screen is a physical barrier that provides protection against direct contact with exposed 1500 V overhead wiring equipment.

Safety screens shall be designed in accordance with T HR EL 08001 ST *Safety Screens and Barriers for 1500 V OHW Equipment.*

Vertical safety screens shall be used on all new bridges. The safety screens shall be insulated from the bridge structure.

Safety screens shall be provided where footbridge stepways, ramps and landings are adjacent to 1500 V dc OHW equipment and within the clearance requirements specified in T HR EL 08001 ST.

Safety screens shall be designed to have a minimum design life of 50 years.

Polymethyl acrylate and polycarbonate materials shall not be used for safety screens.

12.25. Protection screens

A protection screen is a screen installed on overbridges and footbridges to prevent access to safety screens and to restrict objects from falling or being thrown onto the track below.

Protections screens shall be provided on all new overbridges and footbridges in the 1500 V dc area and shall be configured according to Figure 12.3 b) in AS 5100.1 *Bridge design – Part 1:*

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Scope and general principles. For the purpose of this section, the edge of the travelling lanes may be taken as normal structure gauge for the outer tracks. Refer to ESC 215 for details of normal structure gauge.

Adequate provision shall be made when designing protection screens for the detailing at the ends (for example, adjacent to the abutments), to prevent persons gaining access to the outside of the bridge; the horizontal safety screens; or, to the live, exposed 1500 V dc OHW equipment.

Protection screens shall be designed in accordance with AS 5100. The design shall provide a balance between functionality; aesthetics; sharp edges; effectiveness; value for money; safety for train users and operators; general safety and train operation; and, pedestrian amenity.

Protection screens shall be designed to have a minimum design life of 50 years.

Polymethyl acrylate and polycarbonate materials shall not be used for protection screens.

12.26. Earthing and bonding

In electrified areas, the design of overbridges and footbridges shall provide for earthing and bonding of metallic components on the overbridge or footbridge in order to mitigate touch potential hazards and corrosion of steel. The design requirements for earthing and bonding of all overbridges and footbridges in the electrified area shall comply with the requirements set out in technical note TN 016: 2015.

12.27. Clearances to electrical services and equipment

Electrical services within the rail corridor may include aerial lines; 1500 V dc overhead traction wiring and equipment; and exposed low voltage equipment.

The design and construction of overbridges and footbridges shall ensure that minimum clearances to all electrical power lines and equipment comply with Australian standards, the regulations of the relevant electrical authorities and TfNSW electrical standards.

Where high voltage aerial lines are located above an overbridge or footbridge, appropriate measures shall be taken to ensure that:

- buildings on the bridge shall not be located under the high voltage aerial line. Refer to EP 10 01 00 06 SP *HV Aerial Line Standards for Design and Construction* for prohibited configurations with buildings under high voltage aerial lines.
- risk associated with transfer potential from fallen conductors is mitigated

The deck structure in the vicinity of overhead wiring shall be designed to provide an impenetrable barrier to prevent persons from contacting 1500 V dc equipment.

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12.28. Drawing standards

Construction drawings shall comply with TMD 0001 *CAD and* drafting *manual*, in particular Section 1, Section 2 and Section 3. The constructions drawings shall detail the design loadings; horizontal and vertical clearances; and include any other information that is relevant to ensure that the new structure is constructed and maintained in accordance with the design.

The construction hazards and risks shall be included in the general arrangement in the form of 'safety notes'.

13. Refurbishment of overbridges and footbridges

The design of the refurbishment overbridges and footbridges shall comply with the requirements of this engineering standard.

Refurbishment involves the strengthening, repair or modernisation works for overbridges or footbridges. Refurbishment does not include minor works such as the replacement of deck sheeting, 'like for like' component renewal or painting.

Refurbishment of overbridges and footbridges can include the following works:

- widening the bridge
- extending the bridge by the addition of a span
- replacing the superstructure only
- replacing the substructure only
- strengthening the bridge
- adding canopies or barriers

For guidelines on major refurbishment refer to Appendix B.

The need to increase the capacity of elements that are not directly affected by the proposed refurbishment shall be assessed as part of the project development.

13.1. Design criteria for refurbishment

The design of new structural elements and the strengthening of existing structural elements shall comply with AS 5100, Section 12 of this standard and any specific requirements in this section.

When the refurbishment of an overbridge or footbridge is proposed, the relevant road authority and any other stakeholders shall be consulted in order to ascertain the proposed usage and loading requirements for the structure.

For overbridges, the minimum design live load for new and strengthened structural elements shall be T44.

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For footbridges at stations, the minimum design live load for new and strengthened structural elements shall be 5 kPa.

Modifications to an existing overbridge or footbridge may affect the stability, capacity and serviceability of an existing structure; and the design shall take into account the effects of the modifications on the existing structure.

Disabled access legislation and policies can require the retrofitting of easy access provisions to existing bridges. The new work shall be integrated into the existing structure and shall consider aspects such as aesthetics, materials and thermal movements on the structure overall.

Any previously identified repair work should be undertaken prior to the commencement of a modification or improvement.

Where the refurbishment of an existing bridge includes providing a new span or widening the bridge, safety screens, protection screens, barriers and approach barriers shall be provided for the entire bridge. Screens and barriers shall comply with the design requirements in Section 12 of this standard.

New safety screens shall be vertical and shall be insulated from the bridge structure. Horizontal safety screens shall be replaced with vertical safety screens.

13.2. Traffic barrier replacement

This section applies to the replacement of traffic barriers on existing bridges, where no other major refurbishment is undertaken.

The traffic barrier performance level ascertained in accordance with AS 5100 shall be provided. At bridge locations that cannot economically sustain traffic barriers to the performance level specified in AS 5100, a submission in the form of a business case that includes details such as the outcomes of a risk assessment; cost estimates; and construction methodology shall be provided to the Lead Civil Engineer, ASA for approval.

Where the Lead Civil Engineer, ASA agrees, a traffic barrier risk assessment shall be undertaken in accordance with Clause 10.5.1 of AS 5100.1. The traffic barrier performance level may be determined by either of the following two methods of risk assessment:

- AS 5100.1 Appendix B. The procedure presented in this appendix provides a procedure for the selection of an appropriate road barrier performance level related to traffic conditions and the road environment.
- RMS BTD 2007/08 Rev 1 *Design of Replacement Traffic Barriers on Existing Bridges*. This document provides guidance for performance level of replacement traffic barriers for existing bridges, taking into consideration site specific risks.

The method used to determine the traffic barrier performance level shall be documented.

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The proposed traffic barrier performance level shall not be less than that required by the risk assessment unless approved by the Lead Civil Engineer, ASA. Where the barrier performance level cannot be satisfied, alternative strategies of reducing the risk shall be considered, including load restrictions, speed reductions and advanced warnings signs.

13.3. Collision protection

New and strengthened piers and columns designed for the refurbishment of bridges shall comply with the loading and collision protection requirements set out in AS 5100.

Collision loads on support elements located on platforms shall comply with the requirements in Section 12.8.

The design of the strengthening of support elements shall provide for integral continuous walls, extending a minimum 3 metres on the approach side with a rounded or vee-shaped leading face.

If additional rail tracks are to be installed that would result in an existing overbridge or footbridge being modified or extended; or, an existing abutment being converted to a pier with tracks on both sides, provision shall be made for collision loading from a derailed train on both sides of the pier.

14. Load rating

Load rating of existing overbridges and footbridges shall be carried out in accordance with AS 5100

15. Collision protection of existing bridges

This section applies to existing bridges that are not subject to refurbishment works.

At risk supports are supports that are not designed for collision loads where an impact from a derailed train could result in the collapse of the superstructure. At risk supports include steel trestles, slender columns and slender rigid frame support legs.

The RailCorp report *Structures over track risk model* identifies bridges in the Metropolitan Rail Area that require protective measures.

A risk assessment shall be carried out in accordance with the process contained in the *Structures over track risk model* report for structures that require investigation but are not explicitly mentioned within that report.

AEOs required to carry out works on bridges that require protective measures may request the *Structures over track risk model report* from the ASA.

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Preferred configurations for collision protection are:

- independent deflection walls
- deflection walls integrated with the piers and columns

If it is not practicable to put in place either of the above configurations, guard rails may be used. Refer to Appendix C for guard rail requirements

Piers, columns and deflection walls shall comply with the structural configuration and geometric requirements set out in AS 5100. In addition, the leading faces of piers, deflection walls or the first column of a group shall be vee-shaped or rounded.

16. Provision of safe areas

The design of new overbridges and footbridges shall make provision for safe areas at track level for authorised staff to stand during the passage of a train.

A safe area exists if the minimum clearance from the track centreline to the face of the wall structure is kinematic envelope + 1200 mm.

Where this minimum clearance cannot be provided, safe areas can be created by providing safety refuges or handhold devices.

If the clearance from the track centreline to the face of the structure is less than kinematic envelope + 600 mm a safe area can be created by providing a safety refuge.

If the clearance from the track centreline to the face of the structure is between kinematic envelope + 600 mm and kinematic envelope + 1200 mm a safe area can be created by providing handhold devices.

The kinematic envelope is the widest swept path of the rolling stock at the location. Where out-of-gauge loads normally operate or are capable of operating, this outline shall be used. The calculation of the kinematic envelope shall be in accordance with ESC 215 and shall be calculated by an AEO.

The spacing of safe areas, safety refuges or handhold devices below an overbridge or footbridge shall be determined by a risk assessment, taking into account factors such as train speed; available sighting distances; minimum warning time for Lookout Working; and the existence of warning light systems. The spacing shall not exceed 20 metres.

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16.1. Safety refuge details

The floor of the refuge shall be at cess level or, with a maximum step up of 200 mm above the cess level.

The minimum dimensions of refuges shall be as stated below:

- height: 2000 mm
- width: 1500 mm
- depth: 700 mm

If the refuge requires telephones, fire extinguishers or other essential items, the width shall be increased to provide the same minimum clear floor area as defined above.

The floor of the refuge shall be level. The refuge shall be kept clear of cables, pipes or other obstructions.

Handrails shall be installed in all refuges to assist staff in keeping their balance during the passage of a train.

Refer to standard drawing CV 0301159 *Standard – All lines – Handhold Devices – General Arrangement* for details of handhold devices in refuges.

16.2. Handhold device details

Handhold devices comprise a pair of vertical handrails, made from galvanised, circular hollow sections of 40 mm nominal diameter, extending 400 mm from the fixed point on the wall. The internal bend shall be at a radius of 160 mm.

The overall height of the handrail shall be 900 mm and the bottom of the handrail shall be positioned at 900 mm above the cess level.

A level standing area at cess level shall be provided between the handhold devices.

Refer to standard drawing CV 0301159 for details of handhold devices.

16.3. No safe place sign

Where clearance to existing structures is less than kinematic envelope + 1200 mm and safety refuges or handhold devices are not provided, structures shall have a ‘no safe place’ sign attached.

The ‘no safe place’ sign indicates there is no safe place in the vicinity of the danger zone at track level at existing bridges. The sign shall comply with standard drawing CV 0282111 *Standard – All lines – Danger Sign “No Safe Place” – General Arrangement*. Figure 1 illustrates the general configuration of the sign.

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Figure 1 – No safe place sign

The 'no safe place' sign is installed at access points to the area in which no safe place exists. Position the sign so that it is clearly visible to personnel at the access points.

The sign may be attached to an overhead wiring structure, a post or a wall structure. Details such as fixing brackets and bolts are shown on the drawing.

The centre of the sign should be positioned approximately 1500 mm above the ground.

The closest part of the sign should not be less than 1800 mm to the gauge face of the nearest running rail. At restricted locations, this may be reduced provided that minimum transit space requirements are met.

If signs are to be attached to overhead wiring structures, they shall not to be attached to an overhead wiring structure with permanent speed signs attached.

Signs shall not be placed on signal posts or signal structures.

17. Street name signs

Street name signs shall be installed on the track side of overbridges.

The name description shall be clearly stated in a conventional street type designation, for example Erskineville Road, Pennant Hills Road or Sunnyholt Road.

17.1. Location

For single and double tracks, signage shall be installed as per below:

- on bridge girder, deck or superstructure: to the left of the track as seen by the train driver as the train approaches the structure. The left edge of sign shall not be more than 2000 mm from the centre of the track.
- fixed onto the protection screen

At locations with more than two tracks, the position of the sign shall be determined on a case by case basis with due consideration of train driver angle of vision, predominant track usage, train direction and other site specific factors.

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17.2. Fixing details

Suitable fixing details shall be designed for each location.

17.3. Front details

The stencilling details for the text shall be as per below:

- black lettering
- white background
- font type in accordance with AS 1744; Series E with medium spacing
- font size of 200 mm

At locations where vandalism may be an issue, signs shall have an anti-graffiti coating applied.

Figure 2 shows a typical configuration of a street sign.

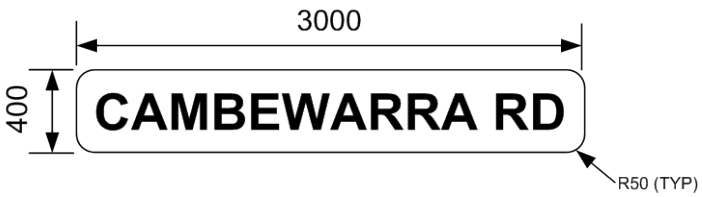

Figure 2 – Typical configuration of a street name sign

17.4. Manufacturing details

Signs shall be manufactured from the following high strength, corrosion resistant aluminium of the grades listed below:

- extrusions: grade 6063 T6 or grade 6061 T6 to in accordance with AS/NZS 1734 *Aluminium and aluminium alloys – Flat sheet, coiled sheet and plate*
- sheet: grade 5251 H38 to in accordance with AS/NZS 1734

The sheet metal used to manufacture the sign shall be 2 mm thick

The material on the sign shall be retro reflective material in accordance with AS 1906.1 *Retroreflective materials and devices for road traffic control purposes – Retroreflective materials.*

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Appendix A RMS Bridge Technical Directions

The following RMS Bridge Technical Directions are relevant to overbridges and footbridges on the TfNSW heavy rail network:

- BTD 2012/01 *Provision of Safety Screens on Bridges*
- BTD 2011/07 *RTA Interim Code for Concrete Design*
- BTD 2010/03 *Pretensioned Bridge Members – Concrete Transfer Strength Requirements*
- BTD 2008/17 *Changes to Standard Bridge Drawings – RC Link Slab for Super T Girder Decks*
- BTD 2008/15 *Concrete Parapets on Pedestrian Overbridges*
- BTD 2008/14 *Changes to Standard Bridge Drawings – Spaced Planks – Standard Drawings*
- BTD 2008/09 *Link Slabs for Precast Pretensioned Concrete Girder Bridges*
- BTD 2008/08 *Provision of Conduits in Bridge Traffic Barriers*
- BTD 2008/06 *Joints in Precast Concrete Barrier Elements on a Grade*
- BTD 2007/08 *Rev1 Design of Replacement Traffic Barriers on Existing Bridges*
- BPC 2005/09 *Provision of Disabled Access for Pedestrian Bridges*
- BPC 2004/10 *Bridge Approach Slabs – Standard Drawings*
- BPC 2003/02 *Waterproofing Membranes for Concrete Bridge Decks*
- BPC 2002/05 *Bridge Concept*

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Appendix B Guidance regarding compliance of refurbishment works

Major refurbishment activity that triggers the requirement to upgrade an existing structure to comply with this standard is defined as work which satisfies both of the criteria below:

- the work is considered as being structural including:
  - widening the bridge
  - extending bridge by the addition of a span
  - replacing the superstructure only
  - replacing the substructure only
  - strengthening the bridge
  - adding canopies or barriers
- the estimated cost of the refurbishment work is greater than 35% of the replacement cost of the existing structure with a new, compliant structure

The replacement of the structure could be a more sustainable option than upgrading the existing structure.

For a footbridge, the structure includes all associated ramps and stairways in addition to the bridge.

Major refurbishment does not include the removal of components, without their replacement, such as ramps, stairways and bridge span(s).

New structures, such as lifts, built adjacent to existing structure that do not rely on that existing structure for support or do not provide support to that existing structure, do not trigger the requirement to upgrade that existing structure. However, the associated changes in usage might require upgrading of the existing structure, in accordance with criteria above.

Refurbishment works adjacent to an existing structure shall take into account the need to develop or replace the existing structures in the future.

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Appendix C Guard rails

The primary function of derailment containment devices on rail tracks is to keep derailed or derailing bogies tracked parallel to and in close proximity to the running rails. In the case of an overbridge or footbridge, guard rails provide a level of protection to an at risk support or element so that in the event of a train derailment, the superstructure does not collapse.

Where the hazard exists on one side of a concrete track slab, a single guard rail can be provided for that side only. Single guard rails shall not be used on ballasted track.

When considering guard rails for a site, it is necessary to confirm that in the event of a derailment, when restrained by the guard rails, the derailed vehicle will be clear of the structure.

Guard rails shall not be used to provide additional risk mitigation for structures that comply with collision loads specified in TfNSW standards.

C.1. Configuration details

The normal arrangement comprises two parallel guard rails (twin guard rails) with a tapered 'vee' section on the train approach side. Standard details for single guard rail installations have not been developed at this stage. Details for single guard rail installations shall be approved by the Lead Civil Engineer, ASA.

Where guard rails are determined to be appropriate to provide protection to at risk supports of overbridges or footbridges, they shall be installed in accordance with the following requirements:

- the guard rail shall be new rail manufactured to AS 1085.1 *Railway track material – Part 1: Steel rails* or recycled rail Category 1 (white rail) in accordance with ESC 220 *Rail and Rail Joints*
- the guard rail section shall be the same section size as the running rail or one section size less than the running rail
- the top of guard rail shall be no higher than the adjacent running rail and no more than 50 mm below the running rail
- each guard rail shall be plated and fastened on both sides to every sleeper. 'A' clips shall be used for fastening the sleeper.
- guard rails shall extend parallel for a minimum 20 metres in advance of the vulnerable support on the train approach side
- the guard rails shall extend parallel for a minimum of 3 metres beyond the vulnerable support on the train departure side

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- a tapered nose section ('vee'), with a minimum length of 3.6 metres shall be installed on the train approach side of the guard rail
- where rail traffic is bi-directional, the guard rail shall extend 20 metres beyond the vulnerable support on both approach and departure sides
- where rail traffic is bi-directional, the tapered nose section shall be installed at both ends
- the clearance between the gauge face of the running rail and adjacent face of guard rail shall be 380 mm
- block-out holes for guard rail fastenings in concrete sleepers shall be grouted with an approved high strength grout

The details contained in the standard drawings listed below may be adopted for guard rails on ballasted track:

- CV 0179048 *Guard Rails Installation of Guard Rails on Ballast Top Underbridge General Arrangement*
- CV 0179050 *Guard Rails Installation of Guard Rails on Ballast Top Underbridge Details of Guard Rail Concrete Sleepers*
- CV 0179051 *Guard Rails Installation of Guard Rails on Ballast Top and Transom Top Underbridges Detail of Tapered Nose Section*
- CV 0558906 *Typical Details – All Lines – Combined ALT 1 & Guard Rail Plate – Details*

These drawings show the dimensional set-out, detail and sizes for componentry, and fixing details for twin guard rails for ballast top concrete sleepered underbridges.

C.2. Signalling interface

Suitable isolation arrangements shall be made, where required, in track circuited and electrified areas.

The tapered nose section ('vee') shall be insulated with an approved component. Figure 3 shows a typical configuration. This insulation requirement applies to new installations and where refurbishment of the guard rails is undertaken.

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Figure 3 – Signalling interface insulation

Where guard rails exceed 50 metres in length, additional insulation and bonding arrangements may be required. Design drawings shall specify that insulation and bonding arrangements and shall be in accordance with the requirements of the Lead Signals and Control Systems Engineer, ASA. For further information, refer to ESG 100.17 *Signal Design Principles Track Circuits.*

C.3. Joints in guard rails

Guard rails on track adjacent to supports of an overbridge or footbridge may have minimal joints with at least two bolts on each side.

If standard fishplates are used, six bolts are required.

If modified fishplates are used, the four bolts shall have all the nuts on the inside. Fishplates shall be modified by machining, not by oxy-acetylene cutting. The plates shall have slotted holes for the bolts.

No joints, other than insulated joints, are permitted in the vee.

C.4. Automatic Train Protection interface

Advice shall be sought from the TfNSW Automatic Train Protection (ATP) project team on guidelines for suitable interface arrangements where ATP balises are installed or where they are proposed to be installed. The final arrangement shall be approved by the Lead Civil Engineer, ASA.

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Appendix D Aesthetic considerations and guidelines

The final appearance and aesthetic qualities of a bridge should be an important consideration in the design process. Bridge structures shall be designed to be functional, safe and economical over their life cycle. Another important design objective is to make them look visually appealing. The overall form of a bridge should have a pleasing appearance and should also look appropriate for its specific location.

Designs for bridge structures should be considered in relation to environmental context. Sensitive contextual design involves being responsive to a particular setting. It is not enough for structures merely to look inoffensive, they should be required to make a positive visual contribution to their surroundings.

Bridges should not only have adequate strength for their purpose, they must also appear to have structural integrity. A bridge should not only express its structural form, it should be physically and visually coherent, having an ordered relationship between the various component parts and the whole composition. There should be overall visual unity and a degree of consistency between bridge elements and materials, and the design details for all of the individual components and their connections, junctions, corners and so on shall be well-resolved.

Creating structures that look good is not simply a matter of taste. Positive visual quality is the result of a design process where careful thought is given to the basic aesthetic principles of scale, form, proportion, order, balance, rhythm, and harmony, from the outset. Simplicity or complexity of structural form, and other aesthetic design considerations such as pattern, colour, contrast and texture also contribute to how a structure will be perceived.

Thinking about how a bridge might look throughout its whole life cycle (that is, over the short, medium and long term future) should be an important part of the design process. Structures should be designed to weather and age gracefully so that the potential unsightly effects of staining, discoloration and vegetation growth can be controlled. Specification of quality materials and surface finishes in combination with good workmanship during construction will help to maintain the aesthetic character of a structure and keep it looking attractive for a long time.

Additional guidance can be found in the RMS publication, *Bridge Aesthetics – Design guidelines to improve the appearance of bridges in NSW.*

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