Standard

Civil Infrastructure Design Standards

Version 1.0

Issued date: 25 May 2017

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Standard governance

**Owner:** Lead Civil Engineer, Asset Standards Authority

**Authoriser:** Chief Engineer, Asset Standards Authority

**Approver:** Executive Director, Asset Standards Authority on behalf of the ASA Configuration Control Board

Document history

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<th>Version</th>
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<td>1.0</td>
<td>First issue</td>
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Preface

The Asset Standards Authority (ASA) is a key strategic branch of Transport for NSW (TfNSW). As the network design and standards authority for NSW Transport Assets, as specified in the ASA Charter, the ASA identifies, selects, develops, publishes, maintains and controls a suite of requirements documents on behalf of TfNSW, the asset owner.

The ASA deploys TfNSW requirements for asset and safety assurance by creating and managing TfNSW's governance models, documents and processes. To achieve this, the ASA focuses on four primary tasks:

- publishing and managing TfNSW's process and requirements documents including TfNSW plans, standards, manuals and guides
- deploying TfNSW's Authorised Engineering Organisation (AEO) framework
- continuously improving TfNSW's Asset Management Framework
- collaborating with the Transport cluster and industry through open engagement

The AEO framework authorises engineering organisations to supply and provide asset related products and services to TfNSW. It works to assure the safety, quality and fitness for purpose of those products and services over the asset's whole-of-life. AEOs are expected to demonstrate how they have applied the requirements of ASA documents, including TfNSW plans, standards and guides, when delivering assets and related services for TfNSW.

Compliance with ASA requirements by itself is not sufficient to ensure satisfactory outcomes for NSW Transport Assets. The ASA expects that professional judgement be used by competent personnel when using ASA requirements to produce those outcomes.

About this document

This standard has been prepared by the ASA in consultation with TfNSW agencies and industry representatives.

This standard is a first issue.
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1. **Introduction**

Light rail civil infrastructure that is designed and constructed in a standardised manner enables consistency, interoperability and efficiency over the whole asset life cycle.

The requirements in this standard are generally limited to the design aspects of light rail civil infrastructure only.

2. **Purpose**

This standard specifies the design standards for light rail civil infrastructure on the Transport for NSW (TfNSW) Transport Network and supplements relevant Australian Standards and other design documents by providing specific TfNSW requirements. These specific requirements include design life, materials and documentation for the structures.

2.1. **Scope**

This standard sets out the civil and structural design requirements for the life cycle of light rail civil infrastructure on the TfNSW Transport Network from concept through to decommissioning for the following:

- bridge structures carrying light rail traffic
- bridge structures over light rail track
- track slabs
- culverts and drainage structures supporting light rail tracks
- retaining walls including reinforced soil walls
- rock bolts and permanent anchors
- earthworks
- drainage
- structural elements of buried utilities
- overhead wiring structures
- acoustic barriers
- cut and cover tunnels

For non-cut and cover tunnels or more complex structures, the provisions of this standard shall be supplemented by other specialist technical literature.

Light rail design traffic loading is also defined.
This document does not cover the following civil infrastructure:

- rail and track
- track clearances
- roads
- pavements
- road barriers
- signage
- traffic signals
- buried structures not loaded by light rail tracks
- vegetation

This standard does not cover requirements for other engineering disciplines such as electrical and signals (including associated fittings and equipment).

2.2. Application

This standard applies to Authorised Engineering Organisations (AEOs) involved in the design of TfNSW light rail civil infrastructure.

Decisions about assets take into account the requirements of this standard and the life cycle cost considerations specified in T MU AM 01001 ST Life Cycle Costing.

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 1657 Fixed platforms, walkways, stairways and ladders – Design, construction and installation

AS 1726 Geotechnical site investigations

AS 2159 Piling – Design and installation

AS 2832 (all parts) Cathodic protection of metals

AS 3600 Concrete structures

AS 4100 Steel structures

AS 4678 Earth-retaining structures

AS 4799 Installation of underground utility services and pipelines within railway boundaries
AS 5100 Bridge Design Set
AS 5100.2:2017 Bridge design – Part 2: Design loads
AS/NZS 1170 (all parts) Structural design actions
AS/NZS 2566 (all parts) Buried flexible pipelines
AS/NZS 3725 Design for installation of buried concrete pipes
AS/NZS 4455 (all parts) Masonry units, pavers, flags and segmental retaining wall units standards series

Transport for NSW standards
Roads and Maritime Services, Bridge Technical Direction Manual
T LR CI 12520 ST Civil Infrastructure Construction
T LR EL 00001 ST Traction Power Systems Requirements
T MU AM 01001 ST Life Cycle Costing
T MU AM 01003 ST Development of Technical Maintenance Plans
T MU MD 00006 ST Engineering Drawings and CAD Requirements

Other reference documents

4. Terms and definitions
The following terms and definitions apply in this document:

AEO Authorised Engineering Organisation
ASA Asset Standards Authority
RMS Roads and Maritime Services
TfNSW Transport for NSW

TfNSW Transport Network TfNSW Transport Network is the transport system owned and operated by TfNSW or its operating agencies upon which TfNSW has power to exercise its functions as conferred by the Transport Administration Act or any other Act.
5. Design standards

Civil infrastructure shall be designed in accordance with this standard, other ASA standards and Australian standards including the following:

- AS 1657 Fixed platforms, walkways, stairways and ladders – Design, construction and installation
- AS 1726 Geotechnical site investigations
- AS 2159 Piling – Design and installation
- AS 2832 (all parts) Cathodic protection of metals
- AS 3600 Concrete structures
- AS 4100 Steel structures
- AS 4678 Earth-retaining structures
- AS 4799 Installation of underground utility services and pipelines within railway boundaries
- AS 5100 Bridge design set
- AS/NZS 1170 (all parts) Structural design actions
- AS/NZS 2566 (all parts) Buried flexible pipelines
- AS/NZS 3725 Design for installation of buried concrete pipes
- AS/NZS 4455 (all parts) Masonry units, pavers, flags and segmental retaining wall units standards series
- Australian Rainfall and Runoff: A Guide to Flood Estimation
- Roads and Maritime Services, Bridge Technical Direction Manual

5.1. Design loading

Bridges and structures which carry road, bicycle or pedestrian traffic over light rail track shall be designed for the loads specified in AS 5100.

Bridges and structures which carry light rail traffic loading shall be designed for 125LA, derived by multiplying the 300LA rail traffic loads specified in AS 5100.2:2017 Bridge design – Part 2: Design loads clause 9.2 by a factor of 125/300, with nine axles. The nine axles are comprised of the simulated locomotive axle plus two groups of four trailing axles. Queuing of light rail vehicles shall also be considered by including additional trailing axle groups based on 100LA.

Light rail traffic live load horizontal forces for bridges and structures can be adjusted in proportion to the ratio of 125LA to 300LA loading specified in AS 5100.
Light rail traffic collision loading and derailment loads for bridges and structures can be adjusted in proportion to the ratio of 125LA to 300LA loading to represent the conditions of moderate derailments and minor collisions. Specific site factors and specialist technical literature shall be considered when determining design collision loads. The minimum design force provisions in this standard and AS 5100 may need to be increased depending on site risks.

5.2. Design life

Civil infrastructure shall have a minimum design life with minimum maintenance as shown below in Table 1.

Table 1 - Design serviceable working life

<table>
<thead>
<tr>
<th>Civil infrastructure type</th>
<th>Design life (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge structures</td>
<td>100</td>
</tr>
<tr>
<td>Bridge barriers (concrete elements)</td>
<td>100</td>
</tr>
<tr>
<td>Bridge traffic barriers (metal elements)</td>
<td>40</td>
</tr>
<tr>
<td>Bridge approach slabs</td>
<td>100</td>
</tr>
<tr>
<td>Bridge deck expansion joints – structural components</td>
<td>100</td>
</tr>
<tr>
<td>Bridge deck expansion joints – rubber components</td>
<td>20</td>
</tr>
<tr>
<td>Bridge deck wearing surface</td>
<td>20</td>
</tr>
<tr>
<td>Bridge deck waterproofing</td>
<td>30</td>
</tr>
<tr>
<td>Bridge walkways (steel)</td>
<td>50</td>
</tr>
<tr>
<td>Bridge bearings – laminated elastomeric</td>
<td>35</td>
</tr>
<tr>
<td>Bridge bearings – others</td>
<td>35</td>
</tr>
<tr>
<td>Culverts</td>
<td>100</td>
</tr>
<tr>
<td>Drainage structures – inaccessible for refurbishment</td>
<td>80</td>
</tr>
<tr>
<td>Drainage structures – accessible for refurbishment</td>
<td>50</td>
</tr>
<tr>
<td>Earthworks</td>
<td>100</td>
</tr>
<tr>
<td>Overhead wiring structures</td>
<td>50</td>
</tr>
<tr>
<td>Primary reinforced concrete structural elements</td>
<td>100</td>
</tr>
<tr>
<td>Rock bolts and permanent anchors</td>
<td>100</td>
</tr>
<tr>
<td>Soil supporting structures including reinforced soil walls</td>
<td>100</td>
</tr>
<tr>
<td>Structural elements of buried utilities</td>
<td>100</td>
</tr>
<tr>
<td>Track slabs</td>
<td>100</td>
</tr>
<tr>
<td>Tunnels</td>
<td>120</td>
</tr>
<tr>
<td>All other assets not described</td>
<td>Industry values of a high standard and quality</td>
</tr>
</tbody>
</table>

The designer of civil infrastructure and associated structural components shall determine any special requirements to protect the structure within the environment and to provide durability to
the structure. In particular, structures in proximity to a marine environment, in a tunnel, dive or cutting require specific protection for long-term durability.

Fatigue life enhancement for light rail bridges and structures shall be included where necessary.

6. Bridge end configuration

Where bridges and culverts carrying light rail traffic are located on a skew the end of the bridge or approach slab shall be shaped to be perpendicular to the track, to avoid twisting of the track structure.

7. Electrical earthing and bonding

The design of civil infrastructure shall provide for earthing and bonding of metallic components in order to mitigate touch potential hazards and corrosion of steel. Earthing and bonding requirements are in T LR EL 00001 ST Traction Power Systems Requirements.

8. Approved materials

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

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.

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

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

9. Drawing standards

Design drawings shall comply with T MU MD 00006 ST Engineering Drawings and CAD Requirements and shall detail the design criteria and all information that is relevant to ensuring that the new structure can be constructed and maintained in accordance with the design. Engineering drawing, computer-aided design (CAD) and submission requirements are specified in T MU MD 00006 ST. Design drawings for light rail civil infrastructure on the TfNSW Transport Network shall be submitted to the TfNSW central planroom (the physical location where drawing information is stored and managed).
Design documentation shall identify standards for design, including loading, materials, foundations, design life, design storms and wind speeds where applicable.

10. **Existing structures**

Where existing civil infrastructure is required to be repaired, any repairs to the structure shall satisfy the structural design action requirements specified in this standard. Whole of life cost considerations shall be taken into account to determine whether to repair or replace structures.

11. **Construction**

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

Civil infrastructure shall be constructed in accordance with T LR CI 12520 ST *Civil Infrastructure Construction* and all project specific requirements as nominated by the designer. This may include relevant references for material testing, testing of welds, fabrication, excavation, erection and tolerances, and the like. The design documentation shall include all requirements and references necessary for completeness of the technical specifications.

The design of civil infrastructure shall take into account construction constraints and restrictions such as the following:

- live operating conditions
- track possession
- on-site geotechnical engineering verification
- staged construction
- trial assembly prior to track possession
- deep cuttings and steep embankments
- other rail infrastructure
- future modifications to the rail corridor

12. **Maintenance**

The design of civil infrastructure shall provide ease of access and visibility to components for inspection and maintenance tasks.

The designer shall carefully select components, materials and finishes that will minimise maintenance during the life of the structure particularly due to the close proximity of these types of structures to operating tracks.
Design and detailing shall consider future replacement which minimises effect on rail operations.

Maintenance requirements shall be specified in the design documentation for structures in the form of a technical maintenance plan. The requirements shall include examination tasks and frequencies, damage limits and repair standards. Site specific maintenance requirements shall also be appropriately documented.

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.*