Oberon Tarana Heritage Railway

Engineering Standard

Structures

OTCS 330

MISCELLANEOUS STRUCTURES

Version 1.0

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Approved by:

.

Oberon Tarana Heritage Railway

Document control

Revision	Date of Approval	Summary of change
1.0	August, 2018	First Issue. Includes content from the following former RIC standards: TS 30 000 3 01, C 2203, CTN 04 16. And CRN CS 330 Ver 1.0

Summary of changes from previous version

Section	Summary of change

Contents

1 Purpose, scope and application

This document specifies the design and configuration requirements for miscellaneous structures

Miscellaneous structures include:

- Retaining walls
- Station platforms. It covers the structural design of the platform. It does not cover the design of the platform surface, except the coping, or the building and architectural design of elements associated with platforms. It specifies requirements for both permanent and temporary structures
- Buffer stops. It applies to all terminal roads and sidings
- Track slabs. It includes requirements for both rigid and floating slabs, the interface with track, the transition between rigid and floating slabs, and the transition to other forms of track support. It covers track slabs where the track is fixed directly to a concrete slab. It does not address the design requirements for floating slabs supporting ballasted track.
- Noise barrier walls
- Rockfall shelters
- Signal gantries
- Lighting and Communications towers.
- Overhead service crossings
- Overhead loading structures
- Unloading bins
- Tunnels.
- Structures over and adjacent to tunnels
- Cranes,
- Storage dams,
- Turntables,
- Water columns and tanks,
- Weighbridges (excluding in-motion types)
- Cattle grids associated with fencing

Air space developments are not included in this standard. These developments are not approved

2 References

2.1 Australian and International Standards

AS 1170 - 2002	Structural design actions
AS 1657 - 1992	Fixed platforms, walkways, stairway and ladders – Design, construction and installation
AS 1726 - 1993	Geotechnical site investigations
AS 2700 Set - 2011	Colour standards for general purposes
AS 2159 - 2009	Piling – Design and installation

AS 3600 - 2009	Concrete structures
AS 4100 - 1998	Steel structures
AS 4678 - 2002	Earth-retaining structures
AS 4680 - 2006	Hot-dip galvanized (zinc) coatings on fabricated ferrous articles
AS 5100 - 2004	Bridge design

2.2 BBRC documents

OTCS 100	Civil Technical Maintenance Plan
OTCS 200	Track System
OTCS 210	Track Geometry and Stability
OTCS 215	Transit Space
OTCS 220	Rail and Rail Joints
OTCS 302	Structures Defect Limits
OTCS 310	Underbridges
OTCS 420	Track Drainage

2.3 Other references

WorkCover NSW Code of Practice	Tunnels under Construction
RTA Specification R57	Design of Reinforced Soil Walls
RTA Specification R271	Design and Construction of Noise Walls
CRN CP 236	Resilient Fastenings
CRN CP 237	Resilient Baseplates
CRN CP 301	Structures Construction
CRN CM 203	Track Inspection

Drawings:

CV 0255592 (205A-326)	Standard Buffer Stop for Terminal Roads
190-211	Cattle Stop Standard Movable

2.4 Definitions

Services:	Underground and aboveground pipelines and cables carrying utilities such as electricity, water, gas, telecommunications and signalling etc.
Trackform:	The type of track structure. May be ballasted or non-ballasted. Ballasted trackform consists of ballast, sleepers, rail fastening assemblies and rails. Non-ballasted trackform consists of concrete slab(s), rail fastening assemblies and rails.
Track Slab:	Concrete slab or slabs with directly fixed track
Rigid Track Slab:	Track slab which is directly fixed to the ground or supporting structure.
Floating Track Slab:	Track slab which is isolated from the ground or supporting structure using resilient bearings.

3 Engineering authority

Design and selection of infrastructure detailed in this standard may only be undertaken by persons who have been granted appropriate Engineering Authority by the Engineering Manager.

4 General requirements

4.1 Clearances

Horizontal and vertical clearances for structures detailed in this standard shall comply with Engineering Standard OTCS 215 “Transit Space”.

The area extending one metre below design rail level of Normal Structure Gauge as detailed in OTCS 215 shall be kept clear of structures and structure footings.

The design of structures shall, where required, also provide clearances for safe places as detailed in Section 19 of this standard.

4.2 Clearances to electrical services and equipment

Electrical services within the rail corridor may include aerial lines and exposed low voltage equipment.

Miscellaneous structures shall be designed and constructed to ensure that minimum clearances are observed to all electrical power lines and electrical equipment, as laid down within the Australian Standards and the regulations of the relevant electrical authorities.

Where high voltage aerial lines are located above a structure, measures shall be taken to ensure that the risk of transferred potential associated with fallen conductors is mitigated.

4.3 Safety

The design of all new miscellaneous structures including the refurbishment of existing structures shall to take into account safety considerations for construction and maintenance personnel, and any other parties including operations personnel who may be required to use or gain access to the structure.

The following special requirements apply:

- Where access is required for personnel to maintain signalling or other services attached to signal gantries safe access shall be provided. This may include access steps, ladders, cages, walkways and fixing points.
- Access & egress shall be designed so that personnel have an unobstructed view of the danger zone and approaching rail traffic.
- Tunnel designs shall comply with the requirements of WorkCover NSW Code of Practice “Tunnels under Construction”.
- Provision shall be made for a safety handrail on top of a retaining wall where the wall height exceeds 2 metres.

4.4 Security

At locations where there is a risk of unauthorised persons gaining access to a structure and endangering themselves or others, security shall be provided by way of fencing or other appropriate means.

4.5 Protection of the environment

The design of all new miscellaneous structures including the refurbishment of existing structures shall take into account environmental impacts during construction and maintenance activities, with a view to minimising any such impacts.

4.6 Heritage

Heritage considerations and classifications must be observed in all designs. This may have particular application in circumstances where an existing structure is being refurbished or modified, or where a new structure is being proposed in the vicinity of existing heritage items.

4.7 Design procedure – new or infrequently used products

If any products specified in the design documentation can reasonably be deemed to be new or infrequently used, these must be identified by the designer and referred to the Engineering Manager for approval. The designer must be satisfied that the manufacturer/constructor/maintainer understands any special requirements/practices relating to the product prior to release of the design documentation.

4.8 Drawing standards

Construction drawings shall comply with standard procedures and formats, and shall detail the design criteria and any other information that is relevant to ensuring that the new structure is constructed and maintained in accordance with the design.

4.9 Construction

In accordance with Design Procedures, design documentation shall identify standards for construction, including construction methods, processes and materials.

The owner has a suite of technical specifications for construction of structures. The specifications are detailed in Engineering Specification CRN CP 301 “Structures Construction” and shall be incorporated in the design and construction documentation for new and refurbished structures.

The design shall take into account construction constraints, particularly live operating conditions and track possession constraints.

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

4.10 Maintenance

The design of all new miscellaneous structures shall take into account the ability to access components for inspection and maintenance purposes.

Components, materials and finishes should be chosen to minimise future maintenance due to the close proximity of the structure to the tracks.

Maintenance requirements shall be specified in all design documentation for structures. Requirements shall include examination tasks and frequencies, damage limits, and repair standards. In most cases, Engineering Standards OTCS 100 “Civil Technical Maintenance Plan”

and OTCS 302 “Structures Defect Limits” will apply. However site specific maintenance requirements may need to be provided.

The following special requirements apply:

- Track slab design shall also consider provision for safe egress from maintenance plant and vehicles from the track onto the track slab.
- Spare components, especially consumables, shall be readily available for buffer stops.

4.11 Mechanical and chemical anchors

Mechanical and chemical anchors may be used to attach minor structures to bridges, tunnels and other structures.

The design documentation shall specify the relevant design and installation criteria.

As the load carrying capacity for these types of anchor is normally based on concrete strength, account must be taken of the age and condition of the concrete or brick structures into which these anchors are to be installed (e.g. fractured concrete or brickwork), in order that the manufacturers" specifications and installation instructions are met.

5 Retaining walls and platforms

5.1 Design standards

Retaining walls and station platforms shall be designed in accordance with AS 4678 - Earth-retaining structures, AS 5100 - Bridge design, other relevant Australian Standards and the requirements of this Standard.

The design of station platforms shall take into account requirements for services and utilities, drainage, public safety and disabled access.

When replacing or refurbishing an existing retaining wall or station platform, the design shall comply with the requirements above and provide for the current and proposed future line usage and business requirements.

Platform reconstruction or refurbishment work shall consider the requirements of all stakeholders. Design options shall consider the following requirements:

- track geometry
- potential impact of track renewal activities (e.g. track re-conditioning)
- clearances to overbridges, footbridges, overhead wiring structures
- current and future rolling stock types
- platform height
- platform length
- platform cross fall (slope away from track)
- building levels
- drainage
- end of platform access stairs
- lighting
- station furniture
- platform fencing

- service conduits
- removal of trees
- heritage issues
- potential impact on existing buildings, structures, entrances, riser height to bridge stairs
- potential impact on signal sighting or signal positioning.

5.2 Approved materials

Approved construction materials for main structural elements are masonry steel and concrete. With the exception of retaining walls less than 900mm high, timber materials shall not be used as structural elements in the design of platforms and retaining walls.

5.3 Formwork

Permanent formwork may be used in the design of retaining walls and platforms, but shall not be structurally significant. The design of steel permanent formwork shall include the mitigation of the effects of stray currents.

5.4 Surface finishes

Designers shall consider aesthetic factors when selecting the form and finishes for retaining walls and should provide a feature finish to large expanses of plain concrete.

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

Where shotcrete is used in refuges, the shotcrete surface shall be steel-floated.

5.5 Earthworks

Earthworks associated with the backfill of retaining walls and station platforms shall be designed in accordance with AS 4678 for compaction and drainage.

5.6 Design requirements

5.6.1 Retaining walls

All retaining walls over 1000 mm high shall be designed by structural engineer with Engineering Authority or shall comply with an approved standard design.

Design of retaining walls and soil-reinforced structures shall comply with AS 4678 and RTA Specification R57 “Design of Reinforced Soil Walls”. The deformation limits in R57 are not necessarily appropriate for rail embankments. The requirements for deformation limits for walls subject to rail loading shall be assessed and the limits in R57 modified appropriately.

Design of soil-supporting structures for bridges shall comply with AS 5100.

Retaining walls shall also be designed for horizontal and vertical surcharge due to derailment loads. The design shall be based on the derailment load cases in AS 5100 and shall consider the worst load case for a structure.

Designs shall take into account site-specific geotechnical parameters.

Retaining walls greater than 2 metres high and any retaining wall supporting rail embankments shall have a design life of 100 years.

Gabion walls shall only be used to support rail embankments where the height of the wall is one metre or less.

The effect of the top one metre of passive fill in front of retaining walls shall be ignored in the design of retaining walls. The passive resistance of shear keys however may be included.

For cantilevered piled walls, the effect of the passive fill in front of the wall to a depth of 1.5 times the pile diameter shall be ignored.

For retaining walls within 3 metres of a track centreline, the top of the footings shall be located at least 1 metre below rail level. This will permit the proper functioning of cess drainage and future ballast cleaning and track reconditioning activities.

Designs shall include appropriate provision for back of wall drainage (e.g. drainage layer, collector pipes and weep holes).

5.6.2 Platforms

Retaining type platform walls shall be designed in accordance with AS 4678.

5.6.2.1 Design loads

Permanent platforms

Permanent station platforms shall be designed for the following loading:

- Vertical: 10 kPa live load
- Lateral: 200 kN ultimate load at any point along the platform
- Longitudinal: 200 kN ultimate load resisted by the end 20 metres of platform (concurrent with lateral load).

Temporary platforms

The provision of temporary station platforms may be required during new construction works or as part of major maintenance work.

If a temporary platform is required to be in service for twelve months or more, it shall be designed for full loading as specified above for permanent platforms.

If a temporary platform will be required for less than 12 months, relaxation of the loading requirements may be allowed as follows:

- Vertical: 5 kPa live load, subject to the platform being used for passengers only and no heavy equipment
- Lateral: 100 kN ultimate load at any point along the platform
- Longitudinal: 100 kN ultimate load resisted by the end 20 metres of platform (concurrent with lateral load).

5.6.2.2 General configuration and drainage

Concrete platform structures are preferred. Steel platform support structures may be used, but they shall comply with the requirements of Section 5.6.2.3. Platform slabs shall be concrete.

The length of platforms shall be determined on the basis of operating requirements and likely future requirements for passenger train consists.

The height of platforms shall be in accordance with OTCS 215.

The width of platforms shall be determined on the basis of usage requirements.

Platform surfaces (including temporary platforms) shall be constructed in durable and impermeable materials that will resist warping, slipping and tripping.

Unrestrained earth slopes beneath open platforms shall be designed to prevent spillage of material onto the track.

Vertical platform walls or piers adjacent to the track shall be placed no closer than 750mm to the edge of the cantilevered coping, to allow for adequate ballast profile and drainage.

Track drainage shall be specifically designed at platforms, particularly in cases where natural run-off from the track structure is interrupted by the platform wall.

The top of footings shall be located a minimum of 1 metre below rail level, to facilitate future ballast cleaning and track reconditioning and to ensure that the platform is not undermined during such activities. If shallow or strip footings are proposed, the footing shall be sufficiently deep below the capping layer to protect against platform instability during track reconditioning works.

The slope of the platform surface shall be designed so that run-off is directed away from the track. A positive drainage system shall be provided to collect and dispose of all stormwater.

5.6.2.3 Steel platforms

The design of steel platforms shall ensure a minimum life to first maintenance of 40 years.

The design shall provide for ease of access for inspection and maintenance of steelwork.

The steel shall have protective coatings in accordance with CRN CP 301.

5.6.2.4 Platform copings

The lateral and vertical placement of platform copings in relation to the track shall be in accordance with OTCS 215.

When refurbishing an existing platform coping, a steel edge may be used.

5.6.2.5 Services

For new structures, services shall be located within utility ducts within the platform.

For existing structures, service cables and ducting may be attached to the platform wall under the coping. Services shall be located no lower than 500 mm from the underside of the coping and extend laterally no more than 300 mm from the platform wall towards the track. Track clearance requirements documented in OTCS 215 shall maintained

5.6.3 Movement joints

Provision shall be made in new concrete retaining walls, platform walls and platform slabs for control of cracking caused by shrinkage and thermal effects.

Movement joints shall be designed to accommodate both contraction and expansion. Design shall be in accordance with AS 3600- Concrete Structures.

Horizontal construction joints are not allowed in walls.

Movement joints shall be provided around fixed objects located in slabs, e.g. structure footings, to prevent damage to the slab.

Movement joints in brickwork / blockwork facing shall be designed to suit facing material.

5.6.4 Ground anchors

Ground anchors shall have a design life of 100 years.

Ground anchors shall comply with the requirements of AS 4678 and Technical Specification S38 “Permanent Rock Anchors” in CRN CP 301.

The designer shall specify requirements for testing. Test procedures shall comply with Technical Specification S38.

The designer shall specify requirements for long term monitoring, if any.

Anchor heads shall be protected so as not to be an obstruction. They shall be recessed or protected by a continuous smooth surface of shotcrete, concrete etc.

5.6.5 Soil nailing

Soil nailing shall comply with the requirements of AS 4678 and Technical Specifications S45 “Reinforced Soil Retaining Walls” and S46 “Soil Nailing” in CRN CP 301.

6 Stop Blocks

6.1 Design standards

Stop blocks shall be a 300mm x 300mm timber bearer secured to the rails. Concrete sleepers may be used in lieu of timber bearers.

The length of over-run area shall be based on the requirements of Section 6.6. The minimum length shall be 5 metres

6.2 Approved materials

Approved construction materials for main structural elements are timber, steel and concrete.

6.3 Location criteria

Stop Blocks may be provided on all lines where trains operate

6.4 Approved configurations

Approved configurations are stop blocks and earth or ballast run-off areas

7 Track slabs

Track slabs are not in use on the OTHR.

8 Noise barrier walls

Not relevant to the OTHR.

9 Rockfall shelters

Rockfall shelters are not relevant to the OTHR.

10 Signal gantries

Not relevant to the OTHR

11 Lighting and communications towers

11.1 Design standards

Lighting and communications towers shall be designed to the relevant Australian Standards and the requirements specified in this document.

11.2 Approved materials

Approved construction materials for main structural elements are steel and concrete..

11.3 Design requirements

The design loads for lighting and communications towers shall be in accordance with the relevant Australian Standards.

The towers shall be designed and configured to meet the functional and performance requirements specified for each site by the tower owner.

12 Overhead service crossings

12.1 Design standards

Overhead Service Crossings shall be designed to the relevant Australian Standards and the requirements specified in this document.

12.2 Approved materials

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

12.3 Design requirements

Overhead service crossings are free-standing structures carrying utility services such as water or sewer mains.

Designs shall comply with the requirements of the relevant Australian Standards, the collision protection requirements of Section 31 of this standard and clearances specified in OTCS 215.

Other design criteria shall be applied as follows:

- design of the structure shall be such that the number of elements that are likely to be struck by a derailed train is minimised. Any columns at track level supporting the structure shall comply with the requirements for pier and column protection in accordance with Section 31 of this document;
- access to OTHR infrastructure shall be maintained as specified for the particular site.

13 Overhead loading structures

Not relevant to the OTHR.

14 Unloading bins (track bearing)

Not relevant to the OTHR.

15 Tunnels

Not relevant to the OTHR

16 Structures over and adjacent to tunnels

Not relevant to OTHR.

17 Minor miscellaneous structures

The following structures are considered minor structures.

- Cranes,
- Storage dams,
- turntables,
- Water columns and tanks,
- Weighbridges (excluding in-motion types)
- Cattle grids associated with fencing

17.1 Cranes, storage dams , turntables, water columns, water tanks and weighbridges

These structures commonly exist on disused lines as well as on operating lines. They shall be maintained in a safe and secure condition that protects public safety.

17.2 Cattle grids

Cattle grids are placed in track at level crossings or at locations where the track intersects fenced properties. Their purpose is to prevent livestock straying across the property boundary.

The current configuration of cattle grids is contained in Plan No. 190-211

It should be noted that some of the older cattle stops function as a waterway. Replacement of these structures with cattle grids may also require installation of appropriately designed culverts or pipes in accordance with OTCS 310.

18 Guard rails

The prime purpose of guard rails on rail tracks is to keep derailed or derailing bogies/ wheels tracked parallel to and in close proximity to the running rails. In the case of an overhead structure, the guard rails afford a level of protection to an adjacent support.

Where guard rails are determined to be appropriate for providing protection to vulnerable supports of overhead or adjacent structures, they shall be installed in accordance with the requirements specified in Engineering Standard OTCS 310 “Underbridges”:

19 Provision of safe areas

19.1 Safety refuges and handhold devices

The design of new tunnels, retaining walls, and other wall structures (e.g. rock shelters or sound barriers) shall make provision for a safe area for infrastructure and other authorised staff to stand during the passage of a train.

A safe area shall be provided where the wall structure is longer than 20 metres.

Safe areas may be provided by:

- Refuges, or
- Hand hold devices

The selection, use and configuration of these items shall be in accordance with the requirements of Engineering Standard OTCS 320 “Overbridges and Footbridges”

Provision for a safe area is not required in the design of platforms

19.2 Locations with limited clearances

Where safe areas (refuges or handhold devices) are not provided, wall structures shall have limited clearance warning signage attached.

The selection, use and configuration of Warning Signs shall also be in accordance with the requirements of OTCS 320.