TMC 521

LEVEL CROSSINGS

Version 2.3

Issued July 2010
Document control

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Chapter 1 Introduction to Manual

C1-1 Purpose

The purpose of this Manual is to detail procedures for level crossings owned and maintained by RailCorp.

The procedures cover:
- installation
- maintenance
- assessment of level of protection
- configuration changes

The Manual applies to road, pedestrian and service level crossings. Service level crossings include track vehicle access points.

This Manual should be used by those responsible for:
- installation and maintenance of civil aspects of level crossings
- determining the appropriate level of protection to be afforded at level crossings;
- reviewing level crossing proposals.

Inspection of level crossings is included in Track Manual TMC 203 “Track Inspection”.

C1-2 How to read the Manual

When you read this manual, you will not need to refer to RailCorp Engineering Standards.

Any requirements from standards have been included in the sections of the manual and shown shaded. The shaded sections in this Manual (see example below) are extracts from RailCorp Standard ESC 520 “Level Crossings”:

The crossing width shall comply with the approved design.

Reference is however made to other Manuals.

C1-3 References

TMC 203 Track Inspection
TMC 211 Track Geometry and Stability
TMC 421 Track Drainage
SPC 522 Track Identification Sign for Track Vehicle Access Point
RailCorp Railway Level Crossing Strategy

Drawings:
CV 0014610 Standard All Lines Hi-Rail Access Crossing Warning Frame - Cantilevered
CV 0014614 Standard All Lines Hi-Rail Access Crossing Warning Frame - Portal
EL 0002915 Railway Overhead Wiring, Railway Level Crossing Warning Sign
M06-244 Pedestrian Crossing, General Arrangement Details
M06-271 Pedestrian/Cyclist Crossing General Arrangement Details

C1-4 Definitions, abbreviations and acronyms

The following defined terms are used throughout this policy:
Level Crossing: A crossing provided for road motor vehicles and pedestrians traffic to cross rail tracks at grade. May also provide access point for hi-rail track vehicles.

Road Level Crossing: A level crossing provided for road vehicles to cross the track.

Pedestrian Level Crossing: A level crossing provided for pedestrians to cross the track.

Service Level Crossing: A level crossing provided for RailCorp staff and persons authorized by RailCorp to cross the track.

Service level crossings may be road or pedestrian crossings, or track vehicle access points.

Service level crossings may be provided at station platforms, in depots and station yards and in field situations for maintenance access.

Service level crossings may be permanent or temporary.

Track Vehicle Access Point: Access point for on and off tracking combination road/rail vehicles.

Level Crossing Structure: An installation, including the associated support system, providing a continuation of the road/pedestrian pavement to enable road vehicles/pedestrians to cross the railway at grade.

Modular Level Crossing: A level crossing manufactured in concrete or rubber modular sections and assembled on site.

Panel: The individual component in a manufactured level crossing structure.

Pedestrian Enclosure: Fenced area to guide pedestrians on the approach to pedestrian level crossings. Includes a maze arrangement for passive control crossings, and a swing gate for active control crossings.

Active Control: Control of the movement of vehicular or pedestrian traffic across a railway level crossing by devices such as flashing light signals, gates or barriers, or a combination of these, where the device is actuated prior to and during the passage of a train through the crossing.

Passive Control: Control of the movement of vehicular or pedestrian traffic across a railway level crossing by signs and devices, none of which are activated during the approach or passage of a train, and which rely on the road user or pedestrian detecting the approach or presence of a train by direct observation.

Crossing Authority: The entity responsible for the road or pedestrian access that the Level Crossing accommodates.

For public roads, the crossing authority is usually the NSW Roads and Traffic Authority (RTA) or the local council.

For private roads, the crossing authority is usually the landowner.

For pedestrian crossings, the crossing authority is usually the local council.

For service crossings, the crossing authority is RailCorp.

Site Supervisor: A qualified civil engineer or a competent person with delegated engineering authority for level crossing construction supervision.

C1-5 Functional Requirements

Level crossings are installed to provide a safe track crossing, at grade, for road and pedestrian traffic. Level crossings may also provide access points for hi-rail track vehicles.

A safe crossing equates to the ability to:
− warn users (rail, road and pedestrian users) of the existence of a level crossing
− warn users of the approach of conflicting traffic with sufficient time for protective action to be taken
− allow for the passage of specified (size, weight and speed) road, rail and pedestrian traffic.
Chapter 2 Management Requirements

C2-1 Introduction

Civil Maintenance Engineers must establish systems to ensure:

1. Compliance with the level crossing strategy.
2. Determination of the appropriate level crossing structure type.
3. Installation and maintenance tasks are undertaken by people who have the required competencies.
4. On-going assessment of level crossing protection configuration to ensure the safety risk at each level crossing remains at an acceptable level.
5. Risk mitigation of passive control crossings if sight distances are not available.
6. Configuration documentation is updated whenever a level crossing is installed or its protection configuration is changed.

Civil Maintenance Engineers and Team Managers are responsible for implementing the requirements of TMC 203 “Track Inspection” in relation to level crossings in their area.

C2-2 Level Crossing Strategy

It is RailCorp’s strategy to:

− Give primary consideration to the safety of the public and rail employees when approving proposals for level crossings.
− Close and remove existing level crossings at every opportunity.
− Promote, develop and implement a program of grade separations.
− Adopt the Level Crossing Strategy Council policy of “No new level crossings”.
− Implement, in conjunction with the Level Crossing Strategy Council, a programme of protection improvements at existing level crossings.
− Enhance safety for pedestrians at existing level crossings, including provision of separate pedestrian facilities.
− Justify level crossing proposals by conducting a safety risk assessment.
− Evaluate and approve level crossing proposals in accordance with RailCorp’s configuration change process.
− Hold proponents responsible for the cost of design and construction of level crossing proposals.
− Accept responsibility for the cost of maintenance of protection devices – signs, signals, booms, gates, pedestrian mazes, hazard tactile warning strips - at the level crossing, but excluding road pavement markings and fences other than boundary fence and pedestrian maze fence.
− At public road level crossings, accept responsibility for the cost of maintenance of level crossing infrastructure between sleeper ends, excluding road pavement markings.
− At other level crossings, accept responsibility for the cost of maintenance of level crossing infrastructure within rail property boundaries.
− In areas of proposed subdivisions or increased road, pedestrian or cyclist traffic, actively pursue closures and grade separations in preference to level crossing enhancements.
− Design, install, operate and maintain level crossings in compliance with RailCorp standards for level crossings.
C2-3 Level Crossing Proposals

C2-3.1 General
Proposals for new level crossings or for configuration changes to existing level crossings shall be managed in accordance with the:

− Level Crossing Strategy;
− RailCorp Safety Management System; and
− Asset Management Group Configuration Management Plan.

Proposals are to include sufficient information to satisfy RailCorp’s configuration management requirements.

Where an external stakeholder such as the Level Crossing Strategy Council (LCSC), the RTA, a local council, a member of the public or a company prefers a level crossing to grade separation, the application is to include a written submission from each such party detailing the reasons for their preference.

Sponsors of level crossing proposals are to include the relevant crossing authorities, the LCSC, and the local Traffic Committee (for RTA or council roads) as stakeholders in the configuration management consultation process.

C2-3.2 New Level Crossings
Proposals for new level crossings, other than service level crossings, shall be supported by a waiver issued by the Level Crossing Strategy Council.

C2-3.3 Closure and Removal of Level Crossings
It is RailCorp strategy to take every opportunity to close and remove existing level crossings. Closure and removal therefore is to be:

− an ongoing consideration;
− investigated whenever there are changed circumstances at a level crossing; and
− pursued whenever the safety risk at a level crossing increases and cannot practically or economically be reduced to an acceptable level.

No level crossing is to be closed and removed unless:

− approval has been granted in accordance with RailCorp’s configuration management requirements;
− the RTA and the local council (in the case of a public level crossing), or the owner of the property served by the level crossing (in the case of a private level crossing), have been formally notified that RailCorp proposes to close the level crossing;
− approval for the closure has been obtained from the Minister; and
− notice of the proposed closure has been published in the Government Gazette.

The submission to the Minister should include the written consent or otherwise of the RTA and the local council (in the case of a public level crossing), or the owner of the property served by the level crossing (in the case of a private level crossing), to the proposed closure.

If any party objects to the closure, the submission to the Minister is to set out RailCorp’s reasons for closing the level crossing despite the objection.
Chapter 3  Competencies

The design of level crossings shall only be undertaken by a person with delegated Engineering Authority for level crossing design.

The installation of level crossings shall only be carried out
- under the supervision of a Site Supervisor, or
- by a person with TDT S10 “Install and/or Remove Minor Structures”

For modular type crossings, the Site Supervisor or person with TDT S10 must be trained in the manufacturer’s procedures for installation.

Inspection of level crossings shall only be carried out by a person with track examination competencies in accordance with TMC 203 “Track Inspection”.

Maintenance of level crossings shall only be carried out by a person with the relevant competencies for the maintenance task:
- Track competencies for any track related activity
- TDT S10 “Install and/or Remove Minor Structures” / trained in manufacturer’s procedures for maintenance of the level crossing structure.
Chapter 4 Construction and Maintenance Acceptance Limits

C4-1 Construction Acceptance Standards
This section specifies the requirements for acceptance of construction and upgrading of level crossings.

C4-2 Track
The track shall comply with the acceptance standards in TMC 211 “Track Geometry and Stability”.

C4-2.1 Level Crossing Structure
The crossing width shall comply with the approved design.

The level crossing structure shall be installed in accordance with the design and good engineering practice.

The surface shall be in good condition with no potential to cause hazard to users.

Modular crossing installations shall comply with manufacturers’ instructions. Panels shall be fully restrained. There shall be no gaps between adjacent panels.

The footpath grade shall comply with the approved design.

Guard rails, fences, pavement markings, track drainage, warning frames, signage including electrical warning sign shall comply with the approved design.

The installation of tactile warning tiles on pedestrian crossings shall comply with drawing number M06-244 “Pedestrian Crossing, General Arrangement Details”.

The level crossing structure installation shall comply with the acceptance limits in Table 1:

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<tr>
<td>Flangeway gap</td>
<td>60 mm min</td>
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<td><strong>Pedestrian Crossings</strong></td>
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<td><strong>Service Crossings</strong></td>
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Table 1 – Construction Acceptance Limits

C4-3 Maintenance Acceptance Limits
This section specifies the requirements for acceptance of level crossings at the completion of maintenance activities.

C4-3.1 Track
The track shall comply with the acceptance standards in TMC 211 “Track Geometry and Stability”.
## C4-3.2 Level Crossing Structure

The level crossing structure shall comply with the acceptance limits in Table 2 on completion of maintenance work:

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<tr>
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*Table 2 – Maintenance Acceptance Limits*
Chapter 5  Installation

C5-1  General

The type of level crossing structure is to be selected as part of the design process and be based on site specific and asset management requirements.

The level crossing structure is to be installed in accordance with the approved design and, where proprietary products are used, with manufacturers’ specifications.

For each installation using a proprietary product, the supplier is to provide an installation and maintenance manual.

The track shall comply with relevant RailCorp Track Engineering manuals and specifications and any specific requirements in the approved design.

Installation of track drainage shall comply with TMC 421.

Traffic control devices and associated equipment shall be installed in accordance with the approved design.

C5-2  Modular Level Crossings

The level crossing structure is designed so that it can be removed, and reinstalled or replaced, either for replacement purposes or to gain access to the track for maintenance or inspection without damage to the component parts of the level crossing structure.

Modular crossings generally rely on correct sleeper spacing to ensure adequate support for the panels. Sleeper spacing is to be checked prior to installing any panels.

A list of approved modular type level crossing products is in Appendix 1.

C5-3  Pedestrian Level Crossings

Base dimensions of a pedestrian enclosure for passive control crossings are detailed in Appendix 2.

Pedestrian enclosures for active control crossings are detailed in Signals Engineering drawing number M06-244 “Pedestrian Crossing, General Arrangement Details” and drawing number M06-271 “Pedestrian/Cyclist Crossing General Arrangement Details”.

C5-4  Service Level Crossings

C5-4.1  Road Crossings

The minimum width of road surface for service level crossings is 3 m.

Approved configurations are:

- asphaltic concrete
- concrete
- concrete panel
- rubber panel
- unsealed road surface
- ballast (temporary only e.g. during possessions/closedowns).

Where road base containing any material that may contaminate the ballast is used it shall be separated from the ballast by a suitable geotextile.

All steel surfaces e.g. rail and fastenings in contact with the road material shall be sprayed with bitumen emulsion.
The surface runoff shall be directed away from the track structure.
The approach road construction shall not interfere with the track and cess drainage.

**C5-4.2 Pedestrian Crossings**

The minimum width of crossing surface shall be 1200 mm.
The walkway surface shall be slip resistant.
Hazard tactile warning strips are not required.
Approved configurations are:
- asphaltic concrete
- concrete
- concrete panel
- rubber panel
- timber
- fibre reinforced plastic grating (in yards and sidings only).

**C5-4.3 Track Vehicle Access Points**

The width of the track vehicle access point crossing shall accommodate the largest vehicle using the crossing.
The surface runoff shall be directed away from the track structure.
The approach road construction shall not interfere with the track and cess drainage.
Where road base containing any material that may contaminate the ballast is used it shall be separated from the ballast by a suitable geotextile.

**C5-5 Prohibited Configurations**

The following configurations are not approved for the RailCorp network because of the potential for shorting track circuits:
- steel level crossings
- level crossing panels with steel edges that extend fully around the panel.

**C5-6 Track Requirements**

**C5-6.1 General**

For installation of road level crossings, the track section through the level crossing should be reconditioned prior to installing the level crossing structure.

The track through the level crossing is to comply with the following requirements:
- formation and capping layer in accordance with TMC 411 “Earthworks Manual”
- concrete sleepers through road level crossings
- rail ground to the required profile if new rail is used
- new rails if existing running rail is worn, including head width wear and head depth wear
- minimum shoulder ballast width of 75mm
- ballast to be compacted/stabilised.

**C5-6.2 Track Drainage**

Level crossing designs shall provide for track drainage through the level crossing structure.
The drainage installation shall be in accordance with TMC 421 “Track Drainage”. The minimum requirement is a slotted pipe located on the top of the capping layer near the toe of the ballast.

### C5-7 Electrical Requirements

Vertical clearances to the overhead wiring at level crossings shall comply with the following requirements:

- the minimum contact wire height under worst sag conditions over a road level crossing is 5.4 metres
- on service road level crossings, the maximum permissible road vehicle height is not more than the contact wire height under worst sag conditions minus 1.0 metre

Warning signs shall be installed on level crossings with overhead wiring. The sign shall be in accordance with drawing number EL 0002915 “Railway Overhead Wiring, Railway Level Crossing Warning Sign”.

On service road level crossings, warning frames shall be installed when the maximum permissible vehicle height is 4.0 metres or less.

Warning frames, where required, shall be located inside the access gate to the rail corridor and on the approach to the level crossing. The design loading shall be a ten (10) tonne truck with a deceleration of 2 m/s² impacting on the swing bar. For typical details, refer to drawing numbers:

- CV 0014610 “Standard All Lines Hi Rail Access Crossing Warning Frame - Cantilevered”
- CV 0014614 “Standard All Lines Hi Rail Access Crossing Warning Frame - Portal”.

Keep rails clear of dirt and mud to minimize effects of electrolysis.

### C5-8 Documentation

On completion of the level crossing installation, drawings shall be updated with work as executed details. The final drawings shall be forwarded to the RailCorp Plan Room.

Whenever a level crossing is installed or its configuration is changed, update the:

- RailCorp Level Crossing Database (DAD); and
- relevant Network Local Appendix.
Chapter 6  Maintenance

C6-1  General
This chapter specifies:
− maintenance responsibilities
− the damage limits for assessment of level crossing condition;
− the maintenance response to damage limits; and
− repair requirements.

Assess defects against the damage limits in C6-3.2.

Take action in accordance with the response categories in C6-3.3.

Carry out maintenance work in accordance with the repair procedures in C6-4.

C6-2  Maintenance Responsibilities

C6-2.1 Public Road Level Crossings
RailCorp is responsible for the maintenance of the level crossing structure and the signs at the level crossing. For this purpose the level crossing structure extends a distance of 1 metre beyond the outer rails.

The road authority is responsible for the maintenance of the approach road and the approach warning signs.

C6-2.2 Private Road Level Crossings
RailCorp is responsible for the maintenance of the level crossing structure, the approach road within the rail corridor and any signs within the rail corridor.

C6-2.3 Pedestrian Level Crossings
RailCorp is responsible for the maintenance of the level crossing infrastructure and signage within the pedestrian enclosures and the track area between the enclosures.

C6-2.4 Service Level Crossings
RailCorp is responsible for the maintenance of the level crossing infrastructure and signage within the rail corridor.

C6-2.5 Sight Distances
The standard sight distances of passive control level crossings shall be maintained.

Trees that can restrict visibility are to be removed or trimmed. Grass and scrub growth is to be maintained to restrict growth height.

No building, structure or fence that would restrict existing visibility is to be erected in the line of sight area at a level crossing.

C6-2.6 Signs
Signs at level crossings are to be maintained in good condition and are to be clearly visible to users of the level crossing.

Civil discipline staff are responsible for signs associated with the level crossing and passive traffic control.

Signals discipline staff are responsible for signs associated with active traffic control infrastructure.
Missing or damaged signs are to be replaced as soon as practicable after detection. Civil discipline staff are responsible for liaising with the road authority for replacement of missing or damaged signs that are the road authority’s responsibility.

C6-2.7 Pedestrian Enclosures
Civil discipline staff are responsible for the maintenance of the enclosure fence, footpath and tactile.

Signals discipline staff are responsible for the maintenance of the swing gates, boom barriers, emergency gates and associated infrastructure.

C6-3 Inspection of Level Crossings

C6-3.1 General
Inspection of level crossings is carried out in accordance with Track Manual TMC 203 “Track Inspection”. In addition, staff are to be vigilant for signs of loose panels.

During track patrol, staff are to look for:
− Major misalignment in panel levels i.e. panel or corner of panel sitting obviously high.

During detailed walking, staff are to look for:
− Visible signs of differential levels in crossing surface between adjacent panels, or between panels and rail head level or adjacent road surface level
− Gaps between panels
− Loose end restraint fastenings.

During detailed examinations, staff are to look for:
− Visible signs of differential levels in crossing surface between adjacent panels, or between panels and rail head level or adjacent road surface level
− Visible signs of localized road surface wear, indicating possible differential loading
− Gaps between panels
− Loose end restraint fastenings
− Movement of panels under road traffic loading.

Note that, except for ‘sitting obviously high’ and ‘movement under load’, the above are indicators only of possible loss of vertical restraint. If the indicators exist, further examination is required to determine if there are any vertical restraint issues.

C6-3.2 Damage Limits
In addition to the limits and responses in TMC 203, level crossing condition is to be assessed against the damage limits and response tables below.

<table>
<thead>
<tr>
<th>LX Structure Security / Condition</th>
<th>Road Crossing</th>
<th>Pedestrian Crossing</th>
<th>Service Crossing</th>
</tr>
</thead>
<tbody>
<tr>
<td>LX structure fully restrained, surface in good condition with no potential to cause hazard to users</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>LX structure not fully restrained – able to move vertically or horizontally</td>
<td>P3</td>
<td>P2</td>
<td>N</td>
</tr>
<tr>
<td>End panel restraining devices loose or damaged, panels not restrained longitudinally</td>
<td>P3</td>
<td>P2</td>
<td>N</td>
</tr>
<tr>
<td>Gaps between panels greater than 5 mm</td>
<td>P3</td>
<td>P2</td>
<td>N</td>
</tr>
</tbody>
</table>
### LX Structure Security / Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Road Crossing</th>
<th>Pedestrian Crossing</th>
<th>Service Crossing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaps between panels greater than 10 mm</td>
<td>P2</td>
<td>P1</td>
<td>P3</td>
</tr>
<tr>
<td>Gaps between panels greater than 20 mm</td>
<td>P1</td>
<td>E2</td>
<td>P2</td>
</tr>
<tr>
<td>Flangeway gap, pedestrian crossing &gt; 65 mm</td>
<td>-</td>
<td>P2</td>
<td>-</td>
</tr>
<tr>
<td>Flangeway gap, pedestrian crossing &gt; 75 mm</td>
<td>-</td>
<td>P1</td>
<td>-</td>
</tr>
<tr>
<td>Uneven surface – Defect size 6 mm to 10 mm when measured with 1.2 m straight edge</td>
<td>N</td>
<td>P3</td>
<td>N</td>
</tr>
<tr>
<td>Uneven surface – Defect size 10 mm to 20 mm when measured with 1.2 m straight edge</td>
<td>P3</td>
<td>P2</td>
<td>N</td>
</tr>
<tr>
<td>Uneven surface – Defect size greater than 20 mm when measured with 1.2 m straight edge</td>
<td>P2</td>
<td>P1</td>
<td>P3</td>
</tr>
<tr>
<td>Top of guard rail &gt; 10 mm above rail</td>
<td>P3</td>
<td>P1</td>
<td>P3</td>
</tr>
<tr>
<td>Top of guard rail &gt; 20 mm above rail</td>
<td>P2</td>
<td>E2</td>
<td>P2</td>
</tr>
<tr>
<td>Top of road surface relative to rail level &gt; ±10 mm</td>
<td>P3</td>
<td>-</td>
<td>P3</td>
</tr>
<tr>
<td>Top of road surface relative to rail level &gt; ±20 mm</td>
<td>P2</td>
<td>-</td>
<td>P2</td>
</tr>
<tr>
<td>Footpath surface level relative to rail/adjacent footpath level &gt; ±5 mm</td>
<td>-</td>
<td>P2</td>
<td>P3</td>
</tr>
<tr>
<td>Footpath surface level relative to rail/adjacent footpath level &gt; ±10 mm</td>
<td>-</td>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>Footpath surface level relative to rail/adjacent footpath level &gt; ±20 mm</td>
<td>-</td>
<td>E2</td>
<td>P1</td>
</tr>
<tr>
<td>Tactiles lifting – creating a trip hazard</td>
<td>-</td>
<td>P1</td>
<td>-</td>
</tr>
<tr>
<td>Tactiles missing</td>
<td>-</td>
<td>P2</td>
<td>-</td>
</tr>
<tr>
<td>Fence panels in pedestrian enclosure damaged</td>
<td>-</td>
<td>P2</td>
<td>-</td>
</tr>
<tr>
<td>Fence panels in pedestrian enclosure missing</td>
<td>-</td>
<td>P1</td>
<td>-</td>
</tr>
</tbody>
</table>

**Table 3 – Damage Limits for Level Crossings**

### C6.3.3  Response

Defects are categorised into one of five standard defect categories as follows:

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Inspect and verify response</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency 2 (E2)</td>
<td>Within 2 hours</td>
<td>Within 24 hours</td>
</tr>
<tr>
<td>Priority 1 (P1)</td>
<td>Within 24 hours</td>
<td>Within 7 days</td>
</tr>
<tr>
<td>Priority 2 (P2)</td>
<td>Within 7 days</td>
<td>Within 28 days</td>
</tr>
<tr>
<td>Priority 3 (P3)</td>
<td>Within 7 days</td>
<td>Program for repair</td>
</tr>
<tr>
<td>Normal (N)</td>
<td>Nil</td>
<td>Routine inspection</td>
</tr>
</tbody>
</table>

**Table 4 – Response to Damage Limits for Level Crossings**
C6-4  Repair procedures

C6-4.1  Flangeway gap
Determine the cause of the gap non-compliance and take relevant corrective action.

Possible causes are:
- rail wear
- guard rail or guard angle connection loose
- panel wear or degradation.

C6-4.2  Guard rail level
Determine the cause of the non-compliance and take relevant corrective action.

Possible causes are:
- rail wear
- guard rail or guard angle connection loose
- panel wear or degradation
- pavement surface degradation.

C6-4.3  Panel restraint/ gaps between panels
Re-install or replace loose panels in accordance with manufacturer’s instructions.

Locations with on-going problems with panel condition and tightness are to be subject to an engineering investigation and possible redesign of the crossing surface.

Repair or replace damaged restraint devices.

C6-4.4  Uneven surface
Repair surface to restore to original condition so that there are no vehicle impact hazards, pedestrian trip hazards or hazards for wheelchairs and bicycles.

Re-install panels and ensure correct support from track structure. If necessary, adjust sleeper spacing.

C6-4.5  Road surface level
Re-install or replace panels where required in accordance with manufacturer’s instructions. If necessary, adjust sleeper spacing.

Repair or replace pavement surface.

C6-4.6  Footpath surface level
Re-install or replace panels where required in accordance with manufacturer’s instructions. If necessary, adjust sleeper spacing.

Repair or replace asphaltic concrete surface.

C6-4.7  Tactiles
Re-attach or replace damaged tactiles in accordance with the design or manufacturer’s specifications.
C6-4.8  **Fencing**

Repair actions shall repair the fence to achieve equivalent performance to a fence in as new condition.

Repairs shall use materials that comply with the design specification.
Chapter 7  Traffic Control Treatments

C7-1  General

There are two types of level crossing traffic control:
- passive control
- active control.

For each type, there are a number of approved configurations.

The type of control and control configuration is based on:
- road/rail/pedestrian traffic volumes
- road speed
- train speed
- sight distance to train
- road and rail track alignment
- roadside activity
- accident history
- number of rail tracks.

Passive control configurations are determined in accordance with this Chapter.

Active control configurations are determined in accordance with RailCorp Signalling Engineering Standards.

Manual gates are a form of active control but the requirements are specified in this Standard.

C7-2  Traffic Control Assessment

Passive control for road crossings on main lines shall only be used where sight distances and sight angles as determined in accordance with C7-3 are available.

If sufficient sight distance is not available to meet the sight distance and sighting angle criteria for passive control, active control shall be installed at the level crossing.

For existing level crossings, if sufficient sight distance is not available to meet the sight distance and sighting angle criteria for passive control, the Civil Maintenance Engineer shall implement appropriate risk mitigation actions. Risk strategies include:
- undertake any necessary works to improve sight distance (eg removal of obstructions)
- impose a speed restriction
- install active control
- close and remove the level crossing.

Sight distance assessments are not required for level crossings in yards and sidings, or for service crossings provided solely for maintenance access.

C7-3  Sight Distance Assessment

C7-3.1  Road Level Crossings

C7-3.1.1  General

The methodology described below for assessing the sight distances for passive control at a road level crossing is applicable to:
- installation of level crossings;
whenever there is any change at a level crossing that requires the sight distances to be reassessed; and
− on-going assessment of the existing configuration of a level crossing.

The minimum sight distance requirements of a level crossing are determined in accordance with the methodology described below.

Level crossings with passive control are to comply with the sight distance requirements.

Existing level crossings that do not comply with the distance requirements are to be upgraded to comply with them.

Minimum sight distance tables are in Appendix 3 of this manual.

Straight sight distance tables are in Appendix 3 of this manual.

Straight-line interpolation applies between values in the sight distance tables.

### C7-3.1.2 Procedure for determining sight distances for road crossings

For the purpose of calculating sight triangles (refer to Figures 1 and 2), the following figures shall be used:
− Distance from driver's eye to the nearest rail when stopped at the stop line - 5 m
− Height of driver's eye above road level - 1.05 m for cars, 2.40 m for trucks
− Height of train above rails – 4.0 m.

The procedure for determining sight distances is:
− Establish whether B-doubles use the level crossing
− Ascertain the road vehicle approach speed (85th percentile speed or road speed limit plus 10%)
− Use the speed board speed for train speed
− Based on road vehicle speed, determine S1 from Table 1 in Appendix 3. This is the sight distance for give way signs for “Stop in advance”.
− For each quadrant, from a distance of S1 metres from the track, determine available sight distance to an oncoming train using survey equipment (refer to Figure 1). This is the sight distance S2 for give way signs “Proceed without stopping”.
− For each quadrant, from a distance of 5 metres from the nearest rail, determine available sight distance to an oncoming train using survey equipment (refer to Figure 2). This is the sight distance S3 for stop signs.

### C7-3.1.3 Procedure for determining sighting angles

In order to ensure that a motor vehicle driver can see along the prescribed sight triangles without excessive head movement or sight obstruction by parts of the vehicle itself the sighting angles as shown in Figures 1 and 2, measured from the direction of travel of the vehicle at the point or points at which sighting must be made, need to be available. The maximum sighting angles are detailed in Appendix 3.

For each quadrant, from a distance of S1 metres from the track, determine available sighting angle for the corresponding sight distance to an oncoming train using survey equipment. This is the sighting angle for give way signs for “Stop in advance”.

For each quadrant, from a distance of 5 metres from the nearest rail, determine available sighting angle for the corresponding sight distance to an oncoming train using survey equipment. This is the sighting angle for give way signs “Proceed without stopping” and for stop signs.
Figure 1 Approach visibility at passive control railway crossings

**LEGEND**

Position 1(i) = Driver approaching crossing sights train, judges that a stop is needed, decelerates and stops at the give-way line.

Position 1(ii) = Driver approaching the crossing either cannot see approaching train or sights train too far distant to be a collision threat, continues at speed and crosses ahead of the train.

$S_1$ = minimum distance of an approaching road vehicle from the nearest rail when driver must be able to see an approaching train in time to stop if necessary before reaching the crossing (metres).

$S_2$ = Minimum distance of a train from the crossing at which a road vehicle driver at distance $S_1$ from the crossing can proceed at speed and safely clear the crossing ahead of that train, (metres).

$V_T$ = the speed of the train approaching the crossing (kilometres/hour).

$V_V$ = the 85th %ile road vehicle speed in the vicinity of the crossing (kilometres/hour). The road speed limit plus 10% may be used where the 85th %ile speed is not known.

$C_V$ = clearance from the vehicle stop or give-way line to the nearest rail (general case assumption = 3.5 metres).

$C_T$ = clearance or safety margin from the vehicle stop or give-way line on the departure side of the crossing (general case assumption = 5 metres).

$L_d$ = distance from the driver to the front of the vehicle (general case assumption = 1.5 metres).

$W_T$ = width, outer rail to outer rail, of the rail tracks at the crossing (metres).

$X_{IL}$ & $X_{IR}$ = sighting angles.

$Z$ = angle between the road and the railway at the crossing (degrees).
Motorist stopped at crossing requires adequate time to accelerate and safely clear the crossing.

**LEGEND**

\[ S_3 = \text{minimum distance of an approaching train from the centre of the crossing, when the driver of the road vehicle must first see an approaching train in order to safely cross the tracks (metres).} \]

\[ V_T = \text{the speed of the train approaching the crossing (kilometers/hour)} \]

\[ L_d = \text{distance from the driver to the front of the vehicle (general case assumption = 1.5 metres).} \]

\[ C_v = \text{clearance from the vehicle stop line to the nearest rail (general case assumption = 3.5 metres).} \]

\[ C_T = \text{clearance or safety margin from the vehicle stop line on the departure side of the crossing - (general case assumption = 5 metres).} \]

\[ W_R = \text{width of the travelled way (portion of the roadway allocated for the movement of the vehicles) at the crossing (metres).} \]

\[ W_T = \text{width, outer rail to outer rail, of the rail tracks at the crossing (metres).} \]

\[ X_{2L} \& X_{2R} = \text{sighting angles measured from the stop line.} \]

\[ Z = \text{angle between the road and the railway at the crossing (degrees).} \]

**C7-3.1.4 Procedure for assessing sight distances and sighting angles**

The procedure for assessing sight distances and sighting angles is:

- Assess the adequacy of the available sight distances for give way and stop signs using Tables 2, 3 and 4 in Appendix 3 of this manual.

  **NOTE:** The sight distance tables are applicable for Single Track ONLY. Additional sight distances will apply for level crossings over multiple tracks.

- Assess the adequacy of the available sighting angles for give way and stop signs using Tables 5 and 6 in Appendix 3 of this manual.

Local weather patterns, such as a high incidence of fog, shall also be considered in the assessment.
If there are doubts about the adequacy of protection configuration at a particular location, request a risk assessment using the Alcam model. Contact the RailCorp Level Crossing Unit to arrange the assessment.

**NOTE:** The step from give way sign to stop sign treatment is not a hierarchical step. It is a function of which treatment matches the sight distance available.

### C7-3.2 Pedestrian Level Crossings

#### C7-3.2.1 Sight Distance

For passive protection to be acceptable, a pedestrian shall be able to sight any train from the pedestrian enclosure at a distance as detailed in Appendix 3.

When assessing sight distance, children’s eye levels, the possibility of rail or other vehicles standing on or adjacent to sidings, the affect of platforms, station buildings and other fixed structures such as overhead wiring structures shall be taken into account.

Local weather patterns, such as a high incidence of fog, shall also be considered.

#### C7-3.2.2 Road Level Crossings Used by Pedestrians

If a road level crossing is used by a significant number of pedestrians, the level of protection to be provided on the road should include assessment of the protection required as a result of the pedestrian usage.

### C7-4 Traffic Control Devices

#### C7-4.1 Passive Control Signage

Passive control signage at level crossings on the RailCorp network shall comply with the requirements detailed in AS1742.7.

Track identification signs shall be provided at locations in multiple track areas where road-rail vehicles are placed on the track. The purpose of the sign is to provide advice of track identification so that people accessing the track with a road-rail vehicle know which track they are on. The sign is to comply with RailCorp Specification SPC 522 “Track Identification Sign for Track Vehicle Access Point”.

#### C7-4.2 Sign details

Sign size is to be in accordance with AS 1742.7.

Sign location, height and orientation shall be in accordance with AS 1742.7.

Signs are to be illuminated or reflectorised in accordance with AS 1742.7.

Signs are to be manufactured in accordance with the requirements of AS 1743 “Road signs — Specification”.

#### C7-4.3 Authorised vehicles only signs

Details of the “Authorised Vehicles Only” sign for service level crossings are:

- Sign generally as per regulatory sign R9-4 in AS 1743
- Sign size 450mm x 300mm
- Letter size of 50mm
- Spacing of 30mm between text lines
- Black text and border on white retro reflective background
- Sign to be made from the following high strength, corrosion resistant aluminium grades:
  - Extrusions: Grade 6063 T6 or 6061 T6 to AS 2848.1 “Aluminium and aluminium alloys —
Compositions and designations – Wrought products⁴
- Sheet: Grade 5251 H38 to AS 2848.1
- Sign sheet metal to be 2mm thick
- Retro reflective material to AS 1906.1 “Retroreflective materials and devices for road traffic control purposes - Retroreflective materials”.

C7-4.4 Active Control Devices
Active control devices - flashing lights, alarms, boom barriers, red man lights, swing gates and associated signage – are to comply with RailCorp Signals Engineering Standards.

C7-4.5 Pedestrian Enclosures
Pedestrian enclosures shall be in accordance with the approved design and C5-3.

C7-4.6 Other
Guard rails, fences, pavement markings, track drainage, warning frames, signage including electrical warning sign shall comply with the approved design.

The installation of tactile warning tiles on pedestrian crossings shall comply with drawing number M06-244 “Pedestrian Crossing, General Arrangement Details” and drawing number M06-271 “Pedestrian/Cyclist Crossing General Arrangement Details”.

C7-5 Standard Control Configurations

C7-5.1 Road Crossings

C7-5.1.1 Minimum Treatment
The minimum treatment is the railway crossing give way assembly. This treatment only applies to single tracks and in situations complying with the limits on use in the table below.

<table>
<thead>
<tr>
<th>Case</th>
<th>85th percentile approach speed: road traffic km/hr</th>
<th>Visibility distance to sign for road users m</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60 max</td>
<td>90 min</td>
<td>Applicable where traffic volume is less than 200 vpd</td>
</tr>
<tr>
<td>2</td>
<td>40 max</td>
<td>40 min</td>
<td>Applicable to any road</td>
</tr>
<tr>
<td>3</td>
<td>any speed</td>
<td>20 min</td>
<td>Applicable only to a crossing on a side road not more than 40 m from the main road</td>
</tr>
</tbody>
</table>

C7-5.1.2 Standard Treatment
The standard treatments are:
- railway crossing give way assembly and advance warning signs and assemblies.
- railway crossing stop assembly and advance warning signs and assemblies.

Signs and assemblies are detailed in AS 1742.7.

C7-5.2 Pedestrian Crossings
Pedestrian crossings on main lines shall have active control.

C7-5.3 Service Crossings

C7-5.3.1 Road Crossings
For service road level crossings on main lines conduct a risk assessment to determine if active control is required.

Approved control methods are:
- Active control devices in accordance with RailCorp Signalling Engineering Standards
- Locked manual gates with controlled issue of keys
- Physical barrier such as two posts and a locked chain, a stop sign and an “Authorised Vehicles Only” sign on each road approach to the crossing (track access crossings only).

The standard treatment at service level crossings in yards and sidings is the railway crossing stop assembly.

C7-5.3.2 Pedestrian Crossings

For service pedestrian crossings on main lines a risk assessment shall determine if active control is required.

Active control devices shall be in accordance with RailCorp Signalling Engineering Standards.

In yards and sidings, the minimum treatment for pedestrian crossings is the look for trains sign as detailed in AS 1742.7.
## Appendix 1  Approved Level Crossing Surface Products

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Supplier</th>
<th>Surface Type</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bodan:</td>
<td>KH1 Pty Ltd</td>
<td>Frameless Polymer Concrete Panel *</td>
<td>√¹, ²</td>
</tr>
<tr>
<td>Holdfast:</td>
<td>Baron Rubber Pty Ltd</td>
<td>Rubber Panel</td>
<td>√¹, ²</td>
</tr>
<tr>
<td>STRAIL:</td>
<td>Phoenix AG (Australia) Pty Ltd</td>
<td>Rubber Panel</td>
<td>√²</td>
</tr>
<tr>
<td>Thermit:</td>
<td>Thermit Australia Pty Ltd</td>
<td>Concrete Panel</td>
<td>-</td>
</tr>
<tr>
<td>Trelleborg:</td>
<td>Trelleborg Engineered Systems Australia Pty Ltd</td>
<td>Rubber Panel</td>
<td>√¹, ²</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td>Asphalitic Concrete</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concrete</td>
<td>√</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FRP Grating</td>
<td>-</td>
</tr>
</tbody>
</table>

* Steel framed panels not allowed

**NOTE**

1. Not where road speed exceeds 80 km/hr
2. Not where angle of road crossing the track is more acute than 30 degrees
3. Pedestrian crossings in yards and sidings only
Appendix 2  Pedestrian Enclosure

Passive Control Enclosure – Base Dimensions
Appendix 3  Sight Distance Tables

1. Sight Distances for Give Way Signs – Stop in Advance

Sight distances are determined using the following equations:

\[ S_1 = \frac{(R_t + B_t)V_v}{3.6} + \frac{V_v^2}{254(d+G)} + L_d + C_v \]

The sight distance table is based on the following values:

- \( R_t = 2.5 \) seconds for \( V_v = 100 \) km/hr
- \( B_t = 1.0 \) seconds for \( V_v < 100 \) km/hr
- \( C_v = 3.5 \) metres
- \( G = 0 \)
- \( L_d = 1.5 \) metres

Hence, the modified equation is:

- \( S_1 = (0.9722 \times V_v) + (V_v^2 / 73.66) + 5 \) (for \( V_v < 100 \) km/hr)
- \( S_1 = (0.9722 \times V_v) + (V_v^2 / 71.12) + 5 \) (for \( V_v = 100 \) km/hr).

\( S_1 \) sight distances are:

<table>
<thead>
<tr>
<th>Vehicle Speed ( V_v ) (km/hr)</th>
<th>Sight Distance ( S_1 ) (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>40</td>
<td>66</td>
</tr>
<tr>
<td>60</td>
<td>112</td>
</tr>
<tr>
<td>80</td>
<td>170</td>
</tr>
<tr>
<td>100</td>
<td>243</td>
</tr>
</tbody>
</table>

*Table 1 – \( S_1 \) sight distances*
2. Sight Distances for Give Way Signs – Proceed without Stopping

Sight distances are determined using the following equation:

\[
S_2 = \frac{V_t}{V_v} \left( \frac{(R_t + B_t)V_v}{3.6} + \frac{V_v^2}{254(d+G)} + \frac{W_t}{\sin Z} + 2C_v + C_t + L \right)
\]

The sight distance tables are based on the following values:

- \( R_t = 2.5 \) seconds, \( d = 0.28 \) for \( V_v = 100 \) km/hr
- \( B_t = 1.0 \) seconds, \( d = 0.29 \) for \( V_v < 100 \) km/hr
- \( C_v = 3.5 \) metres
- \( G = 0 \)
- \( C_t = 5.0 \) metres, \( L = 19.0 \) metres for semi-trailer
- \( W_t = 1.5 \) metres, \( L = 25.0 \) metres for B-Double
- \( Z = 90^\circ \)

Hence, the modified equation is:

\[
S_2 = \frac{V_t}{V_v} \left( 0.972V_v + \frac{V_v^2}{254d} + 1.5 + 7.0 + 5.0 + L \right)
\]

S\(_2\) sight distances are:

<table>
<thead>
<tr>
<th>SEMI-TRAILER</th>
<th>Sight Distance S(_2) (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train Speed ( V_t ) (km/hr)</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>57</td>
</tr>
<tr>
<td>40</td>
<td>115</td>
</tr>
<tr>
<td>60</td>
<td>172</td>
</tr>
<tr>
<td>80</td>
<td>230</td>
</tr>
<tr>
<td>100</td>
<td>287</td>
</tr>
<tr>
<td>120</td>
<td>344</td>
</tr>
<tr>
<td>140</td>
<td>402</td>
</tr>
<tr>
<td>160</td>
<td>459</td>
</tr>
</tbody>
</table>

*Table 2 - S\(_2\) sight distances: Semi-trailer*
<table>
<thead>
<tr>
<th>B-DOUBLE</th>
<th>Sight Distance $S_2$ (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vehicle Speed $V_v$ (km/hr)</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>63</td>
</tr>
<tr>
<td>40</td>
<td>127</td>
</tr>
<tr>
<td>60</td>
<td>190</td>
</tr>
<tr>
<td>80</td>
<td>254</td>
</tr>
<tr>
<td>100</td>
<td>317</td>
</tr>
<tr>
<td>120</td>
<td>380</td>
</tr>
<tr>
<td>140</td>
<td>444</td>
</tr>
<tr>
<td>160</td>
<td>507</td>
</tr>
</tbody>
</table>

*Table 3 – $S_2$ sight distances: B-double*
### 3. Sight Distances for Stop Signs

Sight distances are determined using the following equation:

\[
S_3 = \frac{V_t}{3.6} \left\{ J + G_s \left( \frac{W_R}{2 \tan Z} + \frac{W_T}{\sin Z} + \frac{2C_v}{a} + C_t + L \right) \right\}^{1/2}
\]

The sight distance tables are based on the following values:

- \( J = 2.0 \) seconds
- \( G_s = 1.00 \)
- \( W_R = 6.4 \) metres
- \( W_T = 1.5 \) metres
- \( Z = 90^\circ \)
- \( C_v = 3.5 \) metres
- \( C_t = 5.0 \) metres
- \( L = 19.0 \) metres for semi-trailer
- \( L = 25.0 \) metres for B-Double
- \( a = 0.36 \) m/s\(^2\)

Hence, the modified equation is:

- \( S_3 = 4.29 \times \) Train speed (for semi-trailer)
- \( S_3 = 4.62 \times \) Train speed (for B-double)

\( S_3 \) sight distances are:

<table>
<thead>
<tr>
<th>Train Speed km/h</th>
<th>Semi-Trailer</th>
<th>B-Double</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>86</td>
<td>92</td>
</tr>
<tr>
<td>40</td>
<td>172</td>
<td>185</td>
</tr>
<tr>
<td>60</td>
<td>257</td>
<td>277</td>
</tr>
<tr>
<td>80</td>
<td>343</td>
<td>370</td>
</tr>
<tr>
<td>100</td>
<td>429</td>
<td>462</td>
</tr>
<tr>
<td>120</td>
<td>515</td>
<td>554</td>
</tr>
<tr>
<td>140</td>
<td>601</td>
<td>647</td>
</tr>
<tr>
<td>160</td>
<td>686</td>
<td>739</td>
</tr>
</tbody>
</table>

*Table 4 - \( S_3 \) sight distances*
4. **Sighting Angles**

The following maximum sighting angles need to be available, measured from the direction of travel of the road vehicle at the point or points at which sightings must be made.

For the purpose of calculating sight triangles, the following figures shall be used:
- Distance from driver’s eye to the nearest rail when stopped at the stop line: 5m
- Height of driver’s eye above road level: 1.05m for cars, 2.40m for trucks.

**Give Way Signs**

<table>
<thead>
<tr>
<th>Sighting Location</th>
<th>Sighting Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>To the left approaching give-way sign controlled crossings</td>
<td>95 degrees</td>
</tr>
<tr>
<td>To the right approaching give-way sign controlled crossings</td>
<td>110 degrees</td>
</tr>
</tbody>
</table>

*Table 5 - Sighting angles: Give way sign*

**Stop Signs**

<table>
<thead>
<tr>
<th>Sighting Location</th>
<th>Sighting Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>To the left approaching stop sign controlled crossings</td>
<td>110 degrees</td>
</tr>
<tr>
<td>To the right approaching stop sign controlled crossings</td>
<td>140 degrees</td>
</tr>
</tbody>
</table>

*Table 6 - Sighting angles: Stop sign*
5. **Sight Distances for Pedestrian Level Crossings**

For passive protection to be acceptable, a pedestrian shall be able to sight any train from the pedestrian enclosure at a distance of:

\[
SD = \frac{V}{3.6} \left( \frac{d}{1.0} + 2 \right)
\]

- \(d\) is the distance from front of enclosure on one side of the track to front of enclosure on the other side.
- \(V\) is the speed of the train (km/hr).

For single track, \(d = 6.5\) metres minimum.

For double track, \(d = 10.5\) metres minimum.

When assessing sight distance, children’s eye levels, the possibility of rail or other vehicles standing on or adjacent to sidings, the affect of platforms, station buildings and other fixed structures such as overhead wiring structures shall be taken into account.

Local weather patterns, such as a high incidence of fog, shall also be considered.

Sight distances are:

<table>
<thead>
<tr>
<th>Train Speed km/h</th>
<th>Single Track</th>
<th>Double Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>47</td>
<td>69</td>
</tr>
<tr>
<td>40</td>
<td>94</td>
<td>139</td>
</tr>
<tr>
<td>60</td>
<td>142</td>
<td>208</td>
</tr>
<tr>
<td>80</td>
<td>189</td>
<td>278</td>
</tr>
<tr>
<td>100</td>
<td>236</td>
<td>347</td>
</tr>
<tr>
<td>120</td>
<td>283</td>
<td>417</td>
</tr>
<tr>
<td>140</td>
<td>330</td>
<td>486</td>
</tr>
<tr>
<td>160</td>
<td>378</td>
<td>555</td>
</tr>
</tbody>
</table>

*Table 7 - Sight distances: Pedestrian crossings*