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Level Crossing Construction

ESC-03-01

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1.0	29 May 09		First issue. Supersedes Common Standard SC 03 01 v1.3
1.1	07 Oct 09		Disclaimer updated as per Risk & Safety Committee 14/09/2009. References to Common Signalling Construction Standards numbers updated to new numbering scheme.
1.2	13 Aug 10	All	Issued as final.
1.3	24 Feb 22	Numerous	Transfer of level crossing information from SCP15 and information re focussing of level crossing lights Updated to include interface requirements to Active Advance Warning Assemblies (AAWA) Equipment
1.4	04 Oct 22	1.11.3, 2.3.1	Aligned focusing distances with Appendix 15.

Table of Contents

1 General

1.1 Purpose

This standard sets out the construction requirements for the equipment to be supplied and installed to provide active level crossing protection on road and pedestrian level crossings on the ARTC network.

1.2 Scope

It includes the requirements for flashing light highway signals, boom barriers, pedestrian swing gates, signs, train detection systems, control equipment, power supply and status monitoring.

This standard does not cover the requirements for passive level crossing protection although some aspects of the active crossings will be applicable to both. Passive protection requirements are detailed in ETD-16-02 Level Crossings Design & installation.

The control circuit requirements for the operation of level crossing protection equipment are set out in the approved Signalling Circuit Design for the installation.

The scope of the installation work includes but is not limited to the following:

- Control equipment location cases / buildings.
- Pre-wired equipment racks.
- Level crossing battery boxes and batteries.
- Power supply boxes, switchboards, circuit breaker panels, changeover supplies, surge protection and location earthing.
- Boom barrier assemblies, masts, audible warning devices, mechanisms, signage and boom arms.
- Flashing light assemblies, masts, signage and signal light units.
- Pedestrian mazes and walkways, flashing light assemblies, audible warning devices, swing gate or boom mechanisms.
- Interface with Road Traffic signals where required.
- Cabling and under track crossings, conduits, pits and terminations.
- All reflective warning signs and protective fencing.
- Restoration of roadway surfaces to local Road Authority standards.

Level crossing configurations are to be determined in consultation with the relevant Road Authority and with reference to the guidelines detailed in AS1742 part 7.

The level of protection to be applied at road crossings is to be established using ALCAM and the sight distance requirements.

1.3 Standard Owner

The General Manager Technical Standards is the Document Owner. For any query, initial contact to be made at standards@artc.com.au.

1.4 Responsibilities

Project, Contractor and maintenance team is responsible for the implementation of this standard.

1.5 Safety

All construction activities shall be undertaken so as to ensure the safety of personnel (employees, contractors and visitors) at ARTC sites, and, not cause danger, delay, obstruction or stoppage to railway traffic and not interfere with the business of ARTC or its Operators.

All personnel working on the installation must be appropriately accredited for work on or about Rail corridors in accordance with ARTC Network Operational and Safeworking requirements.

All personnel undertaking installation works to refer local Detailed Site Surveys if available and shall prepare a “dial before you dig” plan of all services within the vicinity of the works before commencing any earth works.

Safe and convenient access of signalling equipment by other railway personnel must be considered and arrangements put in place.

1.6 Work, Health and Safety

All construction personnel shall comply with the relevant safety legislation of the Work, Health and Safety Act.

1.7 Drawings

The documentation and drawings to be used in the execution of the works shall be the approved construction drawings plus any other drawings referenced in the design or nominated in the specification for the work.

1.8 Definitions & Abbreviations

In this document, the following definitions of terms shall apply:

Term or acronym	Description
AAWA	Active Advance Warning Assemblies
AAWD	Active Advance Warning Devices
ARTC	Australian Rail Track Corporation
AREMA	American Railway Engineering and Maintenance of Way Association
Personnel	This includes employees, contractors and authorised visitors
Contractor	A person, company or authority nominated by ARTC or ARTC’s primary contractor to implement specific construction works.
Subcontractor	A person, company or authority hired by ARTC’s Primary Contractor to perform a specific task as part of the overall project.
ARTC’s Representative	A person, company or authority nominated by ARTC to make engineering determinations on ARTC’s behalf.
Type Approved (Materials)	Equipment or materials that is approved by ARTC for application to the ARTC network in accordance any in use constraints.
Road Manager	In relation to a private road - means the owner, or other person responsible for the care, control and management, of the road; or In relation to a public road—means an authority, person or body responsible for the care, control or management of the road

Frangible	As in a frangible pole base designed to break away when a vehicle strikes it. This lessens the risk of injury to occupants of the road vehicle.

1.9 Quality

The standard of materials and workmanship shall ensure that an asset will remain in service for a minimum of 25 years, during which it must remain fit for purpose in its physical and operational environment, in terms of safety, reliability, maintainability, durability, operability and supportability as set out in this Procedure and referenced documents.

All material and equipment shall be manufactured and assembled to provide a minimum service life of 25 years when maintained and/or overhauled at the manufacturer's recommended intervals.

Quality of materials and workmanship shall be such that life cycle routine maintenance of the asset is minimised.

All materials and equipment used in the work shall be warranted free of defect in manufacture or assembly for a period of twelve (12) months from delivery. This warranty shall include lamp-cases, cross-arms, posts and bases, boom barriers and swing gate mechanisms, boom arms, audible warning devices and signs.

General materials such as conduits, grommet's, flanges, nuts, bolts, support brackets and other fastenings shall perform as detailed above. For example, external fastenings and steelwork shall be stainless steel or have corrosion protection such as galvanising, internal fastenings shall be zinc or cadmium plated and external conduits shall be UV resistant.

1.10 Submissions for Approval

All installed equipment must be "type approved" for use on the ARTC Network.

Where alternatives or new equipment types are proposed to meet the design intent, approval for use shall be sought by compiling EGP2101F-01 New Equipment & System Approvals form and submitting this for review as per EGP-21-01.

1.11 Referenced Documents

The following documents are referenced in this standard:

1.11.1 The American Railway Engineering and Maintenance of Way Association (AREMA)

Communications & Signals Manual of Recommended Practices (available for reference from Standards Section upon request).

1.11.2 Australian Standards

AS 1742.7	Manual of Uniform Traffic Control Devices – Railway Crossings
AS 1743	Road Signs Specifications
AS 1074	Steel Tube
AS 1734	Aluminium Sheet and Plate
AS 1874	Aluminium Ingots and Castings
AS 3000	Wiring Rules
AS 3191	Test Specification – Electric Flexible Cords

AS 1650	Galvanising
AS 4209	Stationary Batteries – Lead Acid
AS 3731	Stationary Batteries – Nickel Cadmium
AS 2144	Traffic Signal Lanterns
AS 1428	Design for Access and Mobility
AS 7658	Railway Infrastructure – Railway Level Crossing

1.11.3 ARTC Standards

ESD-03-01	Level Crossing Design
ESD-05-02	HIMA Level Crossing Monitoring Standard
ESC-07-04	Installation of Equipment Racks & Termination of Cables & Wiring
ESC-07-03	Small Buildings, Location Cases, Terminal Cases & General Purpose cases
ESC-09-02	Lightning and Surge Protection Requirements
ESC-07-01	Installation of Trackside Equipment
ESC-11-01	Construction of Cable Routes and Associated Civil Works
ESA-11-01	Cables for Railway Signalling Applications – General Requirements
SPS 08	Level Crossing Monitor Requirements
ESD-09-01	Power Supply Systems
EGP-21-01	New Equipment and System Approval
ESD-09-02	Solar Power Supply Systems
ETD-16-04	Level Crossings Configuration Standard
ETD-16-02	Level Crossings Design & installation
Section 16	Level Crossings
ETW-16-03	Methodology for Measuring Sighting Distances at Level Crossings

1.12 Access Conditions

When working in the vicinity of or adjacent to overhead electrified areas special access conditions shall apply. These requirements are available from the infrastructure manager upon request.

1.13 Production of as constructed documentation

The Constructor shall produce scaled layout plans showing all equipment at the level crossing in its final position in accordance with the ARTC documentation management system. In addition, the Constructor shall update any spatial data base of equipment location or maintenance asset data base referenced in the specification for the works.

2 Road Level Crossings

2.1 General Requirements

All level crossing protection shall, where nominated, comply with the requirements of Australian Standard AS 1742.7 and AREMA C&S Manual. In all situations AS 1742.7 takes precedence.

Updated details of the design and proposed location of level crossing protection equipment shall be prepared by the Constructor. The locations of flashing light signals and boom barrier masts shall be updated into the design as required.

Where location cases are used, the power supply equipment shall be kept separate from the control equipment. Where relocation of any service (e.g. water, gas, electricity etc.) is required, it shall be undertaken with the approval of the relevant service provider.

If for any reason relocation of the service required to construct the works is found to be impractical, alternative arrangements that are compliant with the requirements of the Service owner shall be made or the ARTC representative must be requested to vary the design.

The form of protection and the number of signals required at the crossing (i.e. RX-5 lights, RX-5 lights and half booms, additional RX-5 lights for side roads), shall be advised in the project specification or shown on the site plans.

2.2 Light Units

2.2.1 Light Units – General

Light units shall be classified as either ‘standard size’ (normal diameter of 213 mm) or ‘large size (nominal diameter 305 mm) generally complying with the requirements of the AREMA C&S Manual.

The casing of the light unit shall preferably be made from a cast Aluminium Alloy which meets the requirements of AS 1874. Other materials such as Glass Reinforced Plastic or polycarbonate may be accepted as alternatives upon application to the ARTC Standards Section.

2.2.2 Light Units – LED

Standard size LED units shall be used as the default size for new installations sand shall have a light output greater than 600 Cd . Large size LED units shall have a light output greater than 600 Cd and may be used in situations where a standard size LED unit may not afford sufficient road approach sighting when illuminated.

The LEDs shall be arranged and powered such that an open circuit failure of a single LED affects no more than 25% of the indication and preferably so that short circuit failure of up to 50% of the LEDs in any one string is possible before the entire string fails. The operating voltage range shall be between 8 – 18 volts for a nominal 12VDC system and 18-28 volts for a nominal 24VDC system. Power consumption shall not exceed 16W for standard size units and 22W for large size units.

The unit shall be capable of operating in an environment of –40ºC to +70ºC, 0-95% relative humidity. In-built surge protection of not less than 120v AC for 80 ms and not less than 50v DC for 80 ms shall be provided.

The cover over the LEDs shall be manufactured from clear polycarbonate.

2.3 Light Unit Assemblies (RX5 Flashing Signal Assembly)

Cross-arms assemblies shall be available in two light (uni-directional) and four light (bi-directional) form and generally conform to AREMA C&S Manual Part 3.2.50.

The cross-arm should preferably be made from a cast Aluminium Alloy which meets the requirements of AS 1874 for a medium strength, high corrosion resistant cast aluminium alloy. Alternatively, if fabricated, a medium strength, high corrosion resistant wrought aluminium alloy to AS 1734 may be used.

They shall be mounted on the cross-arm with approximately 760mm between centres and fitted to a pipe mast with lamp centres at a height of 2590mm above road level.

Back to back mounting centres for four light assemblies shall be as shown in AREMA C&S Manual Part 3.2.50 for level crossing protection light installations.

Light units shall be fitted with hoods and backgrounds of the minimum size specified in AREMA C&S Manual Part 3.2.35.

A RX-5 flashing signal and boom assembly is shown in Appendix A, figures 1 and 2.

2.3.1 Focussing of Level Crossing Lights

Level crossing lights shall be aligned to provide the drivers of road vehicles with the maximum possible warning of the stop indication commensurate with the road speed limit approaching and over the level crossing. Designers will need to refer to the specific beam spread for each type of LED lamp as this beam spread will vary depending on the supplier – reference should be made to the individual product and type approval documentation. Refer to Appendix C for indicative alignment drawings for LED type light units. Focusing of the level crossing lights shall be compliant to the stopping sight distance requirements of AS1742.7.

For most straight or near straight approach conditions, the left side lights facing approaching traffic shall be focused for the long range view and the backlights of the signal on the other side of the crossing shall be focused for the short range view and for a vehicle stationary at the stop line.

For curved approaches, the backlights of the signal on the other side of the crossing may be focused for short range view for a vehicle stationary at the stop line, or used also to provide additional coverage on the approach depending on the extent of the curvature so that the loss of sight (‘black spot’) of road signal on the approach to the crossing is minimised.

For multi-lane roads with no median strip / traffic island, both the left side lights shall be focused for the long-range view. Backlights on the signals on the other side of the crossing shall be focused for the short-range view and for a vehicle stationary at the crossing.

For multi-lane roads with a median strip / traffic island RX-5 lights shall be provided on or in the median area. Both the left side lights and the lights on the median strip shall be focused for the long-range view. Backlights may be fitted to the RX-5 units on the median strip if the local conditions deem them necessary from a road sighting perspective across the rail corridor. Back lights on the signals on the other side of the crossing shall be focused for the short-range view and for a vehicle stationary at the crossing.

For level crossings near T junctions or cross-roads (where the level crossing is on the side road) the left side lights facing the junction shall be focussed towards where vehicles begin turning into the side road from the main road and the backlights of the signal on the other side of the crossing shall be focussed for the short range view and for a vehicle stationary at the stop line. These backlights may also be used to provide coverage to traffic turning left at the intersection towards the crossing, dependent on the road layout. A second position assembly RX-5 shall be installed on the right-hand side of the road if necessary, to ensure controls are clearly visible to traffic turning from either direction.

For level crossings near junctions where there a side streets or driveways connected to the main road on which the level crossing is situation, crossing controls (including active warning signals)

shall be visible to vehicles as they commence their turn onto the main road. A second position assembly RX-5 shall be installed on the right-hand side of the road if necessary, to ensure controls are clearly visible to traffic turning from either direction.

Lights focussed for the long-range view (for a straight or curved approaches) shall be aligned to distances of:

- 130 metres for road speeds of ≤60 km/h
- 175 meters for road speeds of 70 km/h
- 200 metres for road speeds of 80 km/h
- 250 meters for road speeds of 90 km/h
- 300 metres for road speeds of ≥100 km/h.

A method for aligning incandescent lamp level crossing signals is provided in Appendix B.

A method for aligning LED level crossing signals is provided in Appendix C.

Further information to assist with focussing level crossing lights is included in Appendix D.

For sighting distance on private level crossings, please refer the document Section 16 – Level Crossings.

2.4 Audible Warning Devices

2.4.1 Mechanical Bell– Road Crossings

The level crossing mechanical bell shall generally comply with AREMA C&S Manual Part 3.2.60.

The mechanical bell shall be designed to mount directly on the top of the post and be provided with an adaptor, where required, to suit the diameter of the heavy steel tube used.

The mechanical bell may be fitted with a ‘soft tone’ hammer if there are separate pedestrian facilities provided where nearby residents may be adversely affected by the operation of the bell.

Nominal operating voltage shall be 10v DC and the mechanical bell shall operate to specification within the range 8 – 15 VDC with a strike rate of 150 – 200 strikes per minute.

2.4.2 Audible Warning Device – Active Level Crossing

An equivalent audible warning device may be substituted for a mechanical bell. The audible warning device should be a volume and tone adjustable audible device that mimics the tone and strike rate of a mechanical bell detailed in Section 2.4.1.

The device shall be Top of Post (ToP) mountable such that it can be mounted and secured on both post sizes used at level crossings. It shall be housed in a suitably corrosion resistant protected steel or aluminium housing

The nominal operating voltage of the audible warning device shall be 12v DC with an operating range of 8–18v DC.

2.4.3 Electronic Warning Device – Pedestrian Crossing

The electronic warning device shall be a volume adjustable audible warble alarm.

These are 2 types typically used.

- within pedestrian swing gate enclosures

- atop of pedestrian 'Red Man' posts.

Where used atop of 'Red Man' posts they shall be manufactured from a corrosion resistant material and enclosed within a corrosion protected steel or aluminium housing that is a hinged and lockable cage. The top of the cage shall be solid covered to reduce the effects of UV exposure to the unit.

The nominal operating voltage of the audible alarms shall be 12v DC with an operating range of 8–18v DC.

2.5 Masts

Masts and bases shall be hot dipped galvanized to AS 1650 after fabrication.

Where there is no audible warning device to be fitted on top of the mast, galvanized sealing caps shall be provided.

Terminals used in bases and masts shall be type approved or equivalent type agreed by regional signal maintenance engineer.

2.5.1 Flashing Light Mast

For RX5 installations where no boom barriers are installed (lights and bell only) the mast shall be a 100mm nominal bore heavy steel tube (114mm O.D) to AS 1074.

2.5.2 Boom Barrier Mast

For RX5 installations where boom barriers are installed the mast shall be a 125mm nominal bore heavy steel tube (140 mm O.D) to AS 1074.

2.5.3 Frangible Base

The base of the mast as described in sections 2.5.1 and 2.5.2 shall be a split cast base that shall provide a frangible element between the post assembly and the foundation. This will mitigate the damage to level crossing equipment and a road vehicle that may impact it.

Fully fabricated steel post base designs are not permitted, as they are not frangible.

2.6 Boom Barrier Mechanisms

Mechanisms should preferably be operated by an electric motor driving through a gearbox, with an effective low current hold – clear device, and shall generally comply with the requirements of AREMA C&S Manual Part 3.2.15.

The boom mechanism shall meet the following requirements:

- The nominal operating voltage shall be 12v DC with an operating range of 8–18v DC
- Power down assist shall be provided between 90º and 50º
- Descent time:refer to ESD-03-01
- Raise Time: refer to ESD-03-1
- Maximum current shall not exceed 15A at 9v for maximum length booms that the supplier of the barrier machine specifies.

The circuit controller shall provide the following contacts for control and operation of the gate mechanism.

- Those required for control of the gate mechanism

- 85º - 90º for light control
- 90º - 10º for bell control
- 5º - 0º for gate down indication

Under failure conditions crossing entry booms shall free fall to the horizontal position and effective snubbing shall be provided.

2.7 Boom Barrier Arms

Boom barrier arms shall be manufactured from Glass Reinforced Plastic (GRP) or from a combination of aluminium and GRP. If combination construction, the maximum nominal length of the aluminium section should not exceed 4.8 metres.

The nominal length of a boom arm shall be measured from the centre line of the mast, on which the mechanism is mounted, to the tip of the boom arm.

The tip of the boom arm shall not extend beyond the centre line of the carriageway for undivided roads and not beyond the edge of the median strip on divided roads.

GRP or combination Aluminium / GRP boom arms shall be fitted with breakaway mechanisms and/or shear pins or similar where attached to the gate arm support.

Boom arms shall be finished in engineering grade or high density retro-reflective red and white diagonal stripes complying with AS1742.7. Height of the boom barrier above ground level in its lowered position should be between 850mm to 1000mm.

2.8 Boom Arm Lights

Boom lights shall be visible to road traffic on both sides of the level crossing.

The light shall take the form of a 75 – 100 mm diameter or square red single sided light affixed to both sides of the barrier arm.

The number of boom lights for various lengths of boom shall be in accordance with AS1742.7 and as a minimum be three (3) with one (1) fixed at 450mm from the tip of the boom arm. The tip light shall display a steady red light when operated with the other two flashing alternately with the main flashing light signals.

LED light units provided shall be the same size and as a minimum, the same intensity of indication. In-built redundancy, operating voltage range and surge protection shall be as specified in Section 2.2.2.

2.9 Signs and Road Markings

2.9.1 Constructor Supplied Items

The configurations of signs and their layout at level crossings shall comply with AS 1742.7 and AS 1743.

The Train Drivers Approach sign shall be installed such that there is one for each railway approach to the level crossing at the point at which the train is detected within the level crossing warning equipment’s control system area.

This signage shall be consistent with relevant addendums to the Code of Practice for the Defined Interstate Rail Network.

2.9.2 Other Signage

All roadside approach warning signs shall comply with AS 1742.7 and AS 1743 and any relevant Road Authority requirements.

2.10 Enlarged Background

When the road alignment is such that the sun will rise or set behind the level crossing signals when viewed from the road approaches, a large background should be fitted to the light unit assembly. This background shall be additional to the standard backgrounds fitted to the light units. One only background is required per flashing light signal assembly.

The post and base mounting arrangements shall be appropriate for the additional wind loading of the enlarged background.

2.11 The enlarged background details are shown in Appendix A, figure 4.Guard Rails

Guard rails are not required for ARTC purposes.

In some states of Australia, the Road Manager require the provision of guard rails on protected level crossings. Where this is the case the Road manager will arrange for the installation of guard rail/s. The Road Manager will be responsible for the maintenance of all guard rails installed – including their replacement if damaged.

The Constructor shall liaise with the Road manager and if required position the flashing light and /or boom arm mechanism foundations such that the guard rail/s can be accommodated.

2.12 Foundation

Flashing Light and Boom arm mechanism foundations can be either poured in situ or pre-cast concrete foundation type assembly.

The foundation shall be of sufficient size, shape and depth in ground to support fully dressed masts in wind speeds up to 160 kph with concrete strength at 28 days being not less than 20 MPa.

The centre of the foundation should be 3.5 metres from the nearest running face of the nearest rail and minimum 2.5 metres from the edge of the sealed pavement or roadside curbing/gutter.

The top of the concrete foundation should be level with the road pavement level or, where curbing / gutters are provided no more than 75mm above the top of the curbing/gutters.

Holding down bolts in foundations shall be 24 mm hot dip galvanised steel and shall be fitted with galvanised flat washers, nuts and locknuts.

Masts shall be installed and levelled so that the signal mast is vertical.

Upon completion of the levelling, the mast base shall be grouted with low shrinkage concrete grout and all loose packers removed.

3 Pedestrian Crossings

3.1 General Requirements

The level of protection to be applied to pedestrian crossings, both independent crossings and those associated with roadways, is provided in ESD-03-01 Level Crossings - Design Principles.

Where the relocation of any service (e.g. water, gas or electricity) is required, approval shall be obtained from ARTC of the service to carry out the relocation, or arrangements shall be made with ARTC to have the relocation carried out.

If for any reason relocation of the service is found to be impractical, alternative proposals to avoid the service shall be submitted.

Care shall be taken to ensure that the audible warning devices at pedestrian crossings, which have a directional sound output, are adjusted to face towards approaching pedestrians and, as far as possible, away from any residence in the vicinity. The volume of these devices is internally adjustable and shall be adjusted so that the warning becomes audible at 10 to 15 metres from the crossing under average ambient noise conditions. There is no benefit to the pedestrian if the device is audible at greater distances.

3.2 Pedestrian Light Units

Light Units for crossings whether fitted with lights only or with swing gates or booms shall be fitted with 200mm LED pedestrian lanterns displaying “Red Man” to AS 2144. Unless otherwise specified, there shall be two lantern units on each side of the crossing, one light facing oncoming pedestrians and one light facing across the railway tracks.

“Red Man” lights shall be;

- nominal 12 VDC systems with an operating range of 8 – 18 VDC; or
- nominal 24VDC systems with an operating range of 18-28 VDC;or
- nominal 110 VAC systems with an operating range of 90 – 130 VAC

In Queensland a “Green Man” (Walk) symbol shall be displayed when the “Red Man” is extinguished.

Open circuit failure of a single LED shall not result in more than 33% loss of indication and the indicated symbol shall remain identifiable.

3.3 Pedestrian Gate Mechanisms

3.3.1 General

Swing gate mechanisms are the preferred method of providing protection at pedestrian level crossings where protection additional to the “Red Man” lights is required.

Pedestrian boom gate arrangements shall only be used where there is insufficient clearance between the access way and the railway line to permit a swing gate to be used. Pedestrian booms shall be driven from an approved mechanism.

Magnetically latched emergency exit gates have been installed at a number of pedestrian level crossings and should be considered for new installations.

3.3.2 Swing Gate Mechanism

The swing gate mechanism shall be capable of operating swing gates up to 1.5 metres in width. Nominal operating voltages shall be 12VDC (8 – 16v) or 110VAC (90 – 130v) 50 Hz. The mechanism shall be capable of:

- Closing the gate (through 90°) within time as specified in ESD-03-01
- Tolerating the gate being restrained part way through its arc for an indefinite period without detriment to the motor or mechanism.
- Resuming movement in the intended direction when restraint is removed.
- Tolerating being forced from the closed or open position without detriment to motor or mechanism.
- Returning to the correct position when the force is removed.

Swing gates shall be of welded metal construction of sufficient strength so as not to distort or sag with a vertical load of 150 kg applied at the tip of the gate.

The gate shall not twist if restrained at top or bottom with a load of 150 kg applied at the tip of the gate opposite the pivot and opposite the restraint.

They shall be non-climbable and similar in construction to swimming pool access gates. Gate supports shall not bend, twist or distort with similar loads applied or with a load of 250 kg applied to the top of the gate support in any direction.

The entire gate shall be hot dipped galvanized to AS1650 after fabrication.

3.3.3 Boom Gate Mechanism

The boom mechanism shall be electric motor driven and capable of operating booms up to 3.0 metres in length. Nominal operating voltages shall be 12VDC (8 - 16v) or 110VAC (90 - 130v) 50 Hz. The maximum current for 12v DC mechanisms shall not exceed 8 amps.

The mechanism shall be gravity drop and shall be counterweighted and/or snubbed to provide a drop time from 90° to horizontal of 6 to 8 seconds with the time from 90° to 50° not less than 2.5 seconds.

The mechanism and counter-weighting shall be arranged so that there is no possibility of the boom failing to drop (or rise as required) under any wind condition likely to be encountered in the location where it is installed.

The hold clear system within the mechanism shall not draw current in excess of 500 mA when in the hold position.

Boom gate arms shall be made from GRP, Aluminium or combination GRP/Aluminium. No lighting is required on the boom gate arm.

Boom gate arms shall be of sufficient length to permit the mechanism to be placed clear to one side of the pathway and to overlap the other side of the pathway (generally through a slot in the fence) by at least 100mm when in the horizontal position.

Boom gate arms shall be finished in gloss white.

3.4 Audible Warning Device

The audible alarm shall be as indicated in Section 2.4.3. Unless otherwise specified one alarm shall be fitted to each side of the crossing, facing oncoming pedestrians. The audible alarm can be turned off, in built-up areas, when the booms are fully lowered and/or Pedestrian gates are closed.

3.5 Pedestrian Masts

The mast shall be 100mm nominal bore heavy tube to AS 1074 and be hot dipped galvanized after fabrication.

3.6 Foundations

The foundations for both Swing Gates and Boom Gates shall be of sufficient size, shape and depth in ground to support fully dressed masts in wind speeds up to 160 kph with concrete strength at 28 days being not less than 28 MPa.

The top of the concrete foundation should be 150 mm above the road pavement level or, where curbing/gutters are provided, 75 mm above the top of the curbing/gutter.

Holding down bolts in foundations shall be 12 mm hot dip galvanised steel and shall be fitted with galvanised flat washers, nuts and locknuts.

Masts and swing gates shall be installed and levelled so that the signal mast or swing gate post is vertical.

Upon completion of the levelling, the mast base shall be grouted with low shrinkage concrete grout and all loose packers removed.

3.7 Signs

The signs to be displayed at pedestrian crossings shall be in accordance with AS 1742.7. They shall be displayed on either side of the crossing in a position where they can be best viewed by approaching pedestrians.

3.8 Pedestrian Access

The pedestrian access and protection include the pathway, tactile tiles where appropriate and pedestrian mazes. Fencing may also be installed on the approach walkways as applicable.

3.9 Fencing

In different jurisdiction, ownership of the fencing is different depending on the SIA. Where ARTC is the owner of the fencing, requirement should be as below.

Fencing for gated and maze crossings shall be 1.5m high weld mesh. Note that non-standard corral fencing may be considered in some circumstances such as heritage sensitive areas, on application to the ARTC Project Manager. Fencing leading up to a crossing corral (gated or maze) shall not be less than 1.0m in height and where associated with existing station platform fencing, should match that fencing. Note that boundary fencing should not be less than 1.8m in height.

4 Control Equipment

4.1 Control of Lights/Booms/Gates

Equipment used to control the operation of road and pedestrian crossings shall have the same safety and reliability characteristics as that required for railway signalling systems and equipment, and be approved for use on the ARTC network. The controls provided must be constructed strictly in accordance with the approved design.

4.2 Flasher Units

Duplicated electronic flasher units shall be provided. The wiring to each highway signal shall be such that the failure of one flasher or the open circuit failure of one wire or connection point shall not result in the total loss of all the highway signals on one side of the level crossing and generally be in accordance with AREMA C&S Manual Part 3.1.10.

The lights shall have a flashing rate of between 35 and 65 flashes per minute.

4.3 Level Crossing Predictors

Where level crossing predictors are used, they must be designed in accordance with ESD-03-02.

4.4 Rail Interface Control Unit

A Rail Interface Control Unit (RICU) shall be provided where an interface is required between the railway crossing system and traffic control system. The design, installation and maintenance of the RICU is the responsibility of the Road Manager, unless agreed otherwise.

The requirements of this unit and associated equipment is detailed in ESD-03-01 Level Crossing Design.

4.5 Active Advance Warning Assemblies

Active Advance Warning Assemblies (AAWA) shall take the form of twin alternating yellow lights mounted on the same post as the W7-4B (or C) road sign, generally within a sign reading “Prepare to Stop” as defined in AS1742.7:2016. Note, this assembly may also be referred to as an RX-11 assembly.

The configuration of the AAWA equipment is the responsibility of the Road Manager. This shall include the design, installation, and maintenance of the associated equipment.

5 Power Supply

5.1 Power Supplies – AC and DC

The power supply arrangements shall be in accordance with ESD-09-01 and ESD-09-02

Lightning and surge protection shall be designed in accordance with ESC-09-02.

The power supply for traffic control equipment (e.g. RICU, AAWD or AAWA) may be sourced from the railway 240V AC supply transformer, providing a separate circuit breaker is provided. If no 240V AC supply is available at the railway crossing (e.g. the crossing is fed from a 415V AC or 120V AC signalling supply), then the Road Manager shall provide their own power supply arrangement. Cable routes for 240V AC power cables outside of the rail corridor shall comply to AS3000. Cable routes for 240V AC power cables within the rail corridor shall comply to ARTC Standards. .

5.2 Batteries

The batteries shall have sufficient capacity to operate the active level crossing protection equipment, associated control equipment, train detection equipment and any railway signalling fed from the level crossing location in accordance with the requirements detailed in ESD-03-01 – Level Crossing Design.

5.3 Battery Chargers

Battery chargers shall be approved and operate in accordance with the requirements of ESD-09-01.

5.4 Solar Power

Where solar power is used, the batteries and solar panels shall be sized to cover the requirements for the specific location. The requirements for these types of systems are detailed in ESD-09-02 – Solar Power Supply Systems.

6 Cables and Wiring

The termination of all cables and wiring shall be in accordance with ESC-07-03 Installation of Equipment Racks & Termination of Cables and Wiring. Cable requirements and configurations permitted for signalling applications are specified in standard ESA-11-01 Cables for Railway Signalling Applications General requirements.

Location power and lighting wiring shall comply with AS 3000.

7 Lightning and Surge Protection

Lightning and surge protection shall be provided in accordance with the requirements of ESC-09-02 Lightning and Surge Protection Requirements.

8 Level Crossing Housing

Equipment for the control and operation of the level crossing shall be housed in a prefabricated sandwich panel walk-in location or alternatively in aluminium or stainless steel location cases, complying with ESC-07-03.

The building or location case shall be located not less than 15 metres from the edge of the roadway and as close to the railway boundary as practical to reduce exposure in the event of an accident and to reduce obstruction to the line of sight of an approaching train.

The level crossing location shall be provided with an identification plate as defined in Section 11.

9 Test/Emergency/Manual Operation and Axle Counter Reset Boxes

The test, emergency, manual operation and axle counter reset boxes (as appropriate) shall be mounted on the outside of this location / building on the side facing the railway line. Boxes shall mounted so that the level crossing, approaching road traffic and RX assemblies are clearly visible to a person operating the switches.

The test, emergency, manual operation and axle counter reset boxes (as appropriate) shall be secured with the nominated padlocks for the particular rail corridor.

10 Telephones

There is no requirement for the provision of a telephone at new level crossing installations.

Communication requirements for maintenance personnel should preferably be achieved by mobile telephone provided coverage is suitable.

As an exception, Telephone line may be installed if there are issues with mobile coverage for particular sites in consultation with local signal maintenance engineer.

11 Reporting Sign

A sign shall be provided that clearly displays sufficient information so that the general public and rail infrastructure workers can report any issues related to the level crossing installation and/or its operation, and includes:

- Level Crossing Identification Number
- Contact telephone number for the controlling signaller
- Level crossing location name, and
- Kilometrage

The sign shall be mounted on the roadway side of the level crossing location or alternatively be positioned such that there is clear visibility to vehicular and pedestrian users of the level crossing.

12 Monitor

The level crossing monitor, monitors the status of a level crossing, logs events, reports warning or failure conditions to a central location, and provides facilities to remotely test the level crossing battery supply.

Each level crossing with active protection shall be fitted with a status monitoring system which is capable of performing tests on specified functions on command and provide indications of faults and warnings to remote control / monitoring location.

The monitoring system shall be in accordance with ARTC standards and requirement and shall provide data that is acceptable as legal evidence in the event of an enquiry following a level crossing fatality, accident or failure condition incident and be currently type approved for use on the ARTC network.

Details of crossing protection operation shall be recorded and retained in the monitor log for a minimum period of 7 days or downloaded to the remote control/monitoring location at intervals which will preclude overwriting of the monitor log.

All stored data shall be accessible for interrogation or download at any time both locally and remotely.

13 Appendix A: Drawings

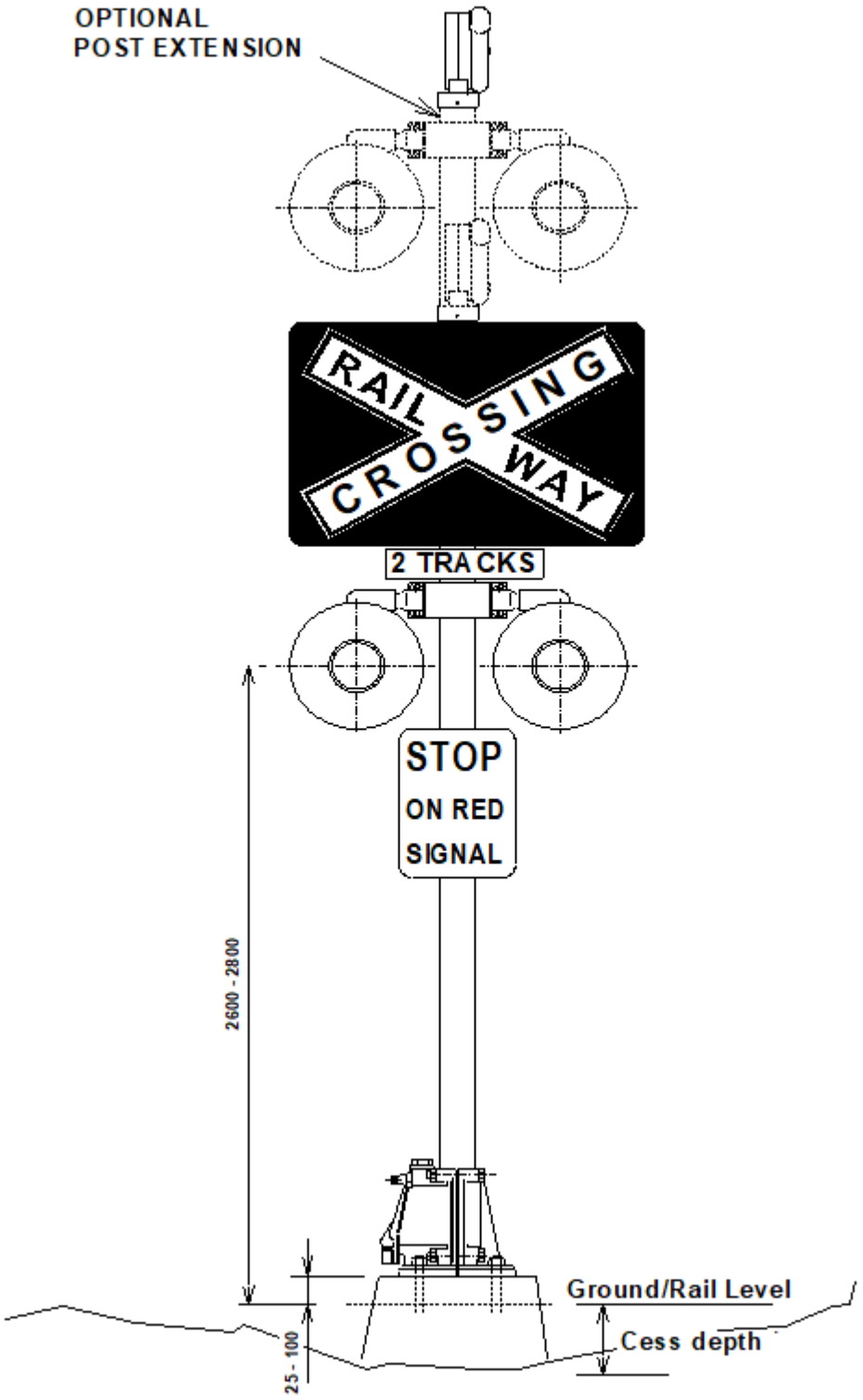
Figure 1: RX-5 Flashing Signal Assembly

Figure 2: RX-5 Flashing Signal Assembly with Boom installation

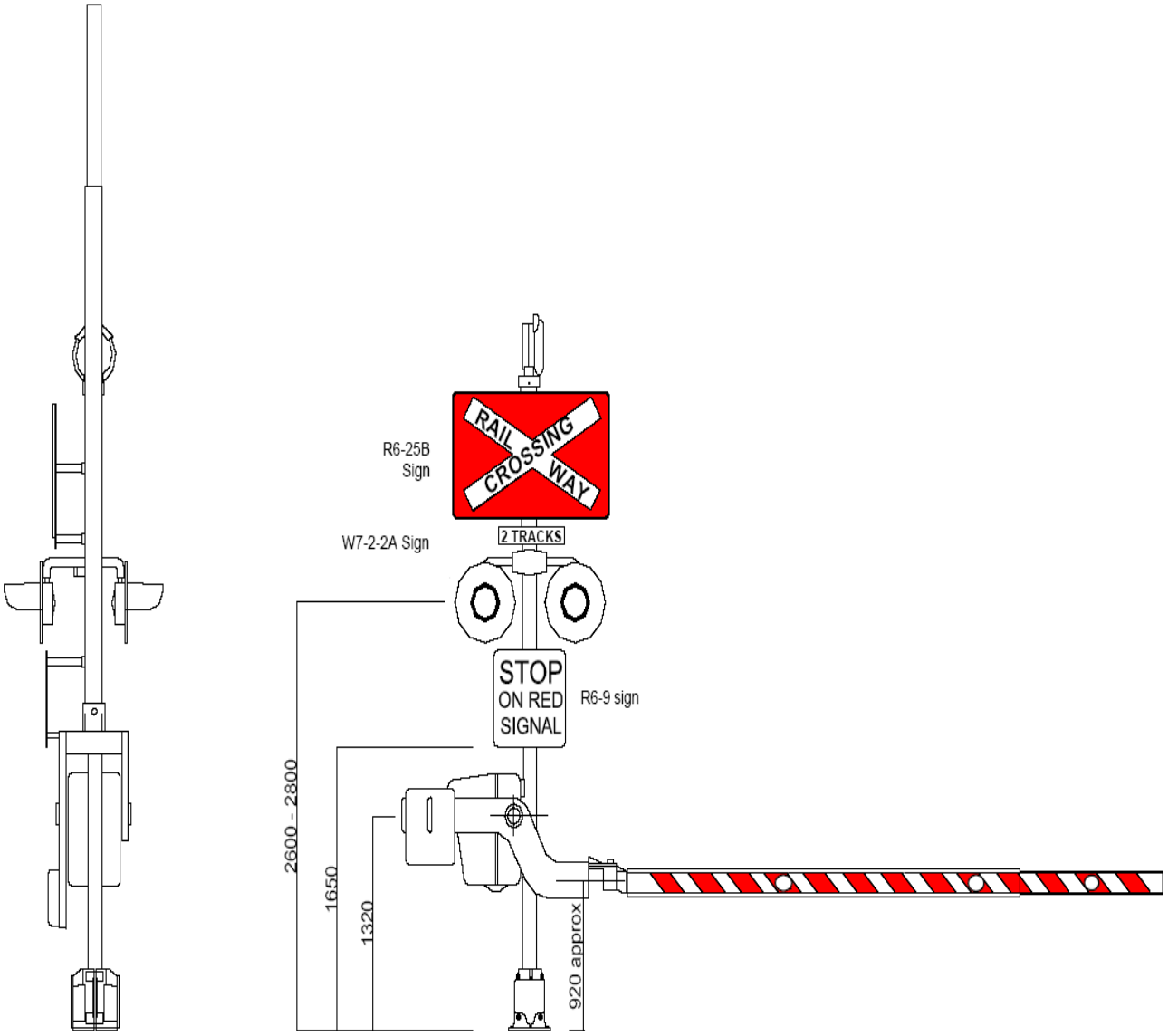
Figure 3: Typical Large Background Details

Note: Drawings are only for reference.

13.1 Figure 1: RX-5 Flashing Signal Assembly



13.2 Figure 2: RX-5 Flashing Signal Assembly with Boom installation

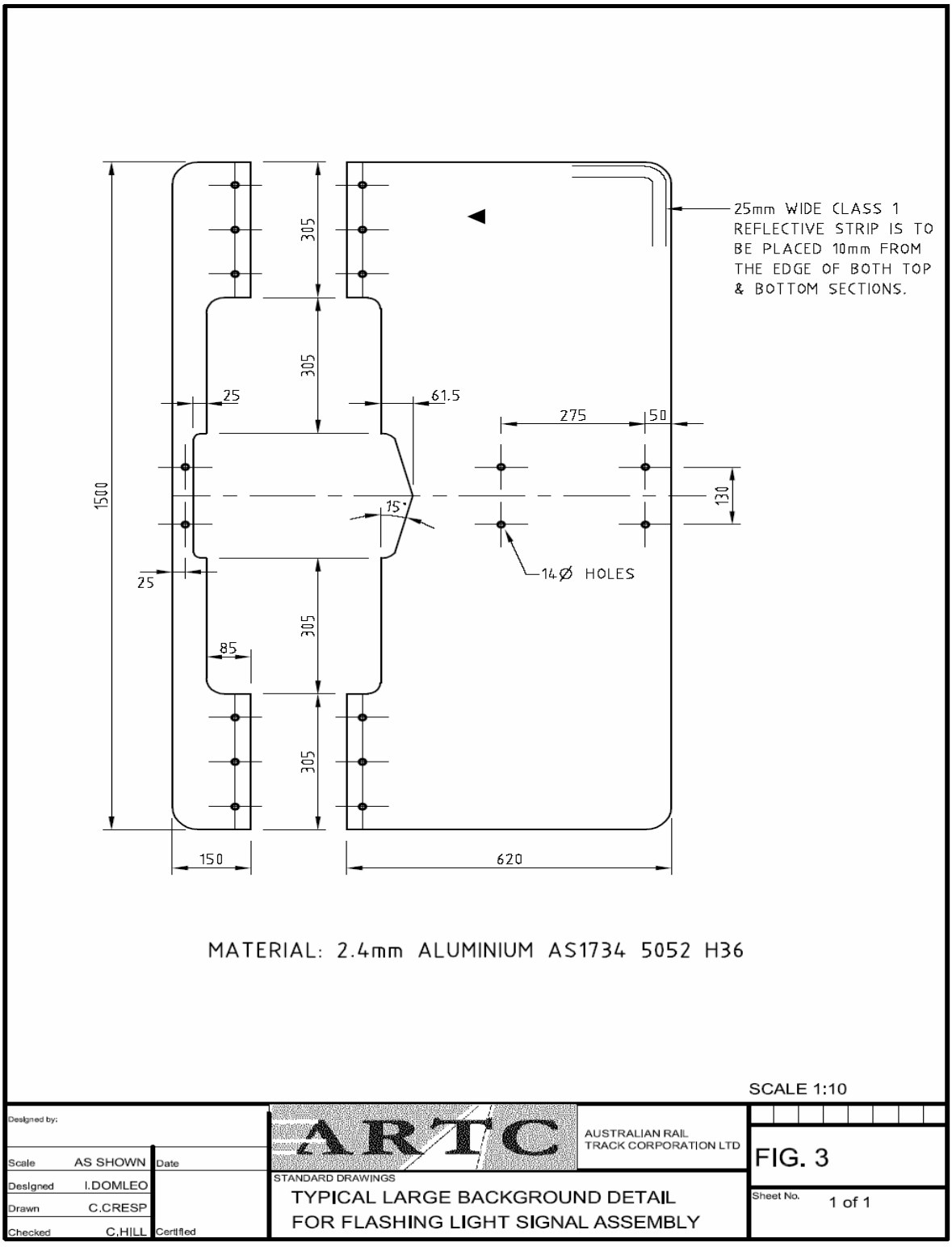


Note:

Where road speed is 60kph or less, the distance between the centreline of the post and road edge should be 2000mm.

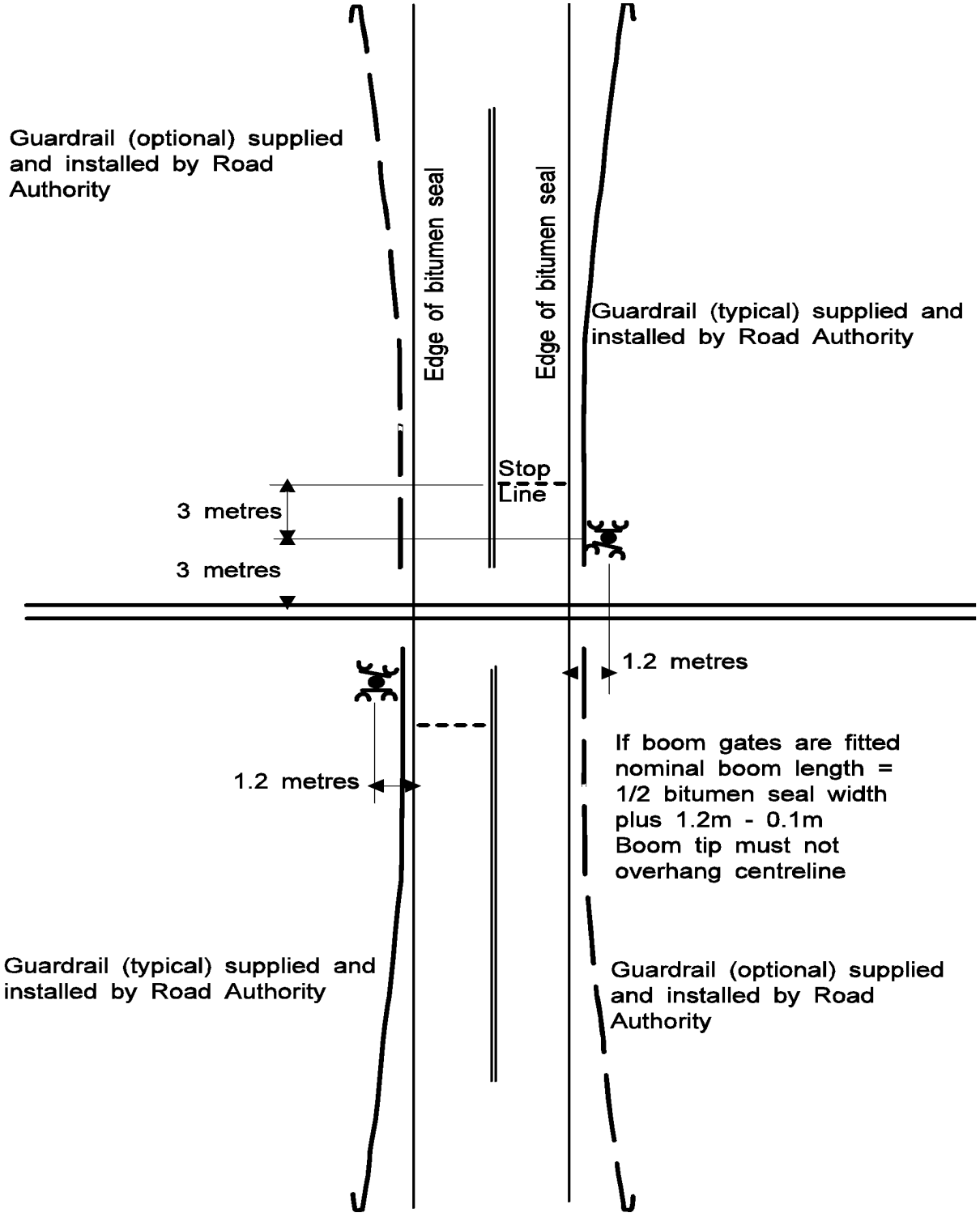
Where road speed is greater than 60kph, the distance between the centreline of the post and road edge should be 3500mm.

13.3 Figure 3: Typical Large Background Installation

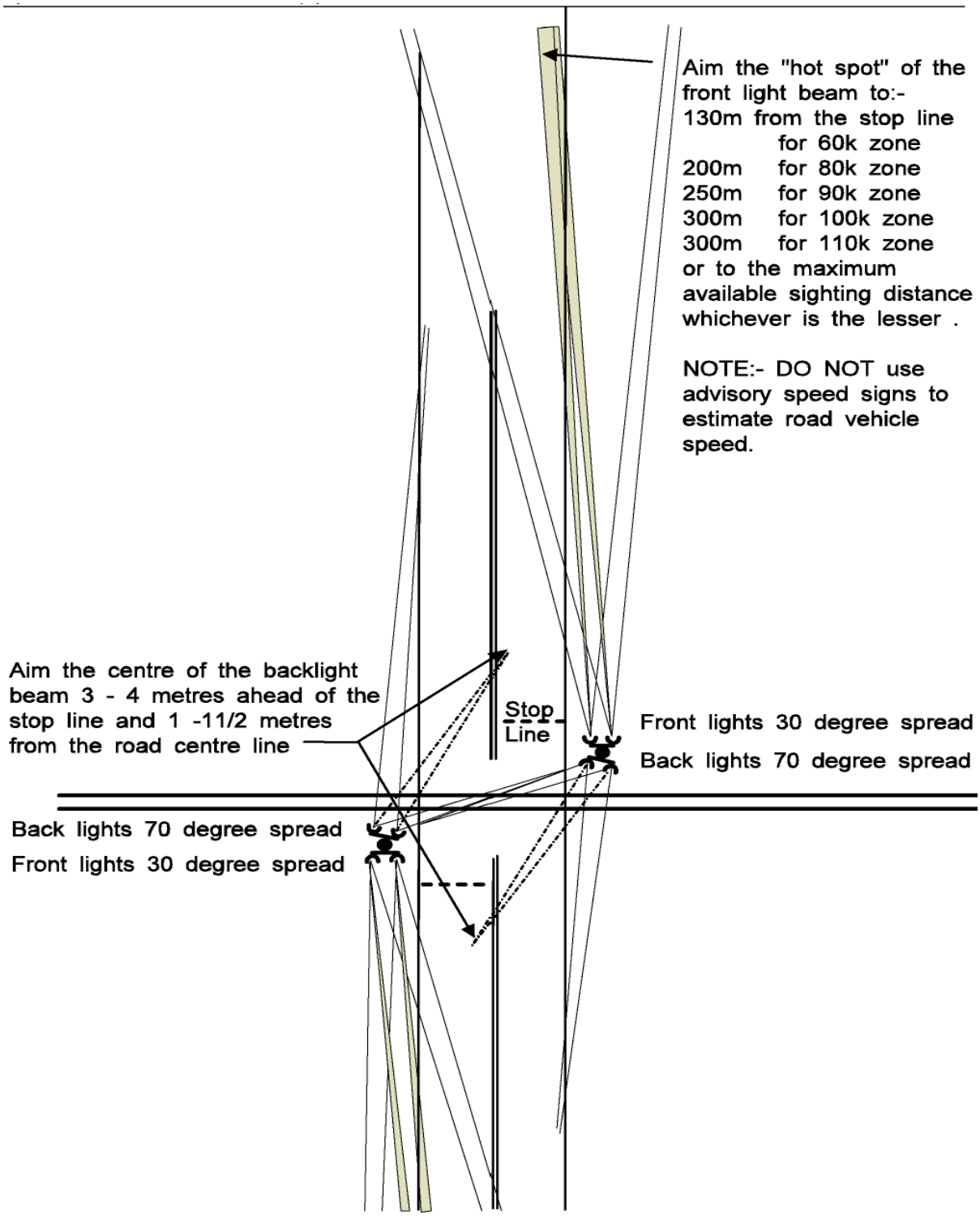


14 Appendix B – Incandescent Lamp Flashing Road Traffic Signal Alignment (focusing)

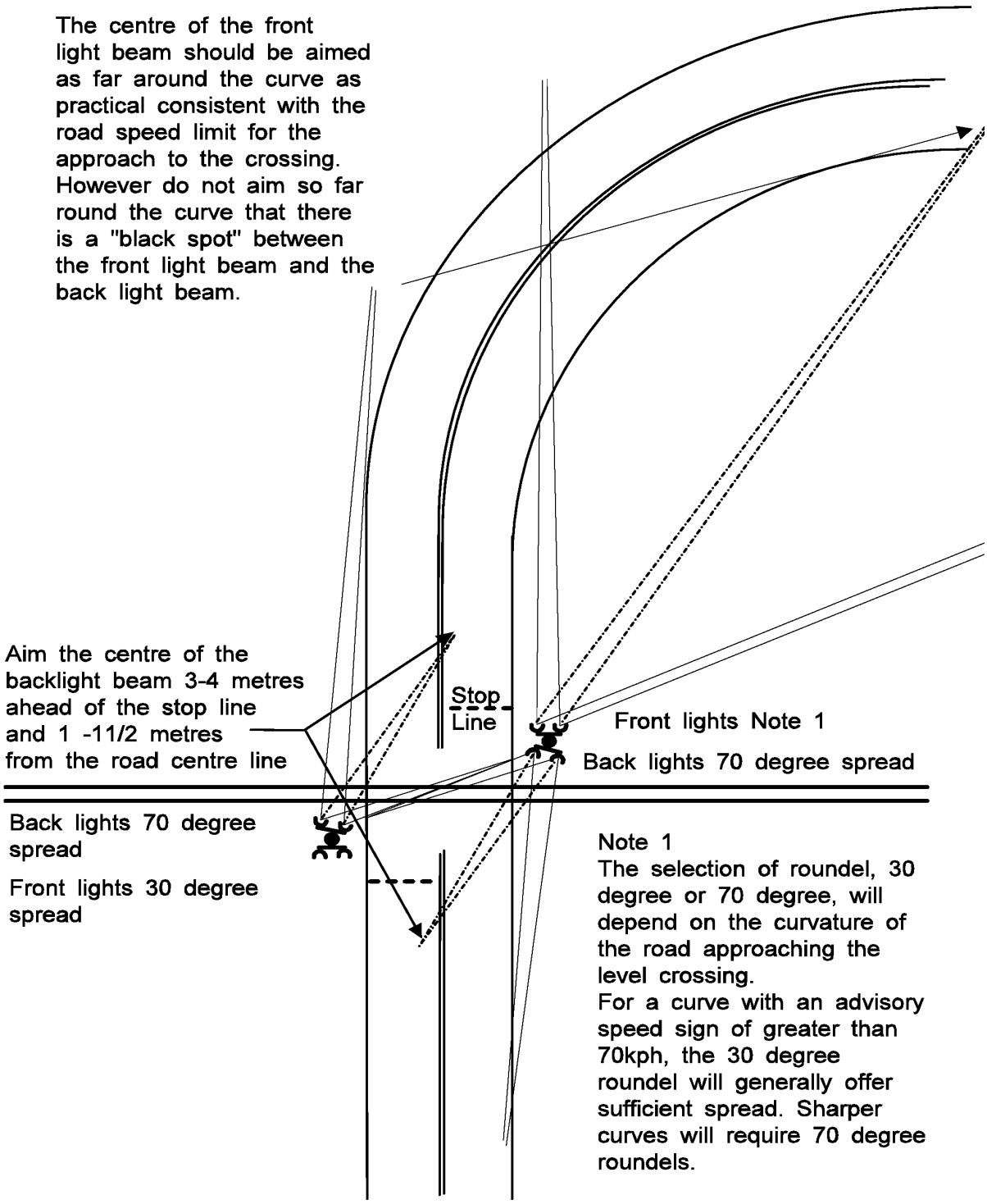
14.1 Figure 4 – Typical Level Crossing Signal Installation



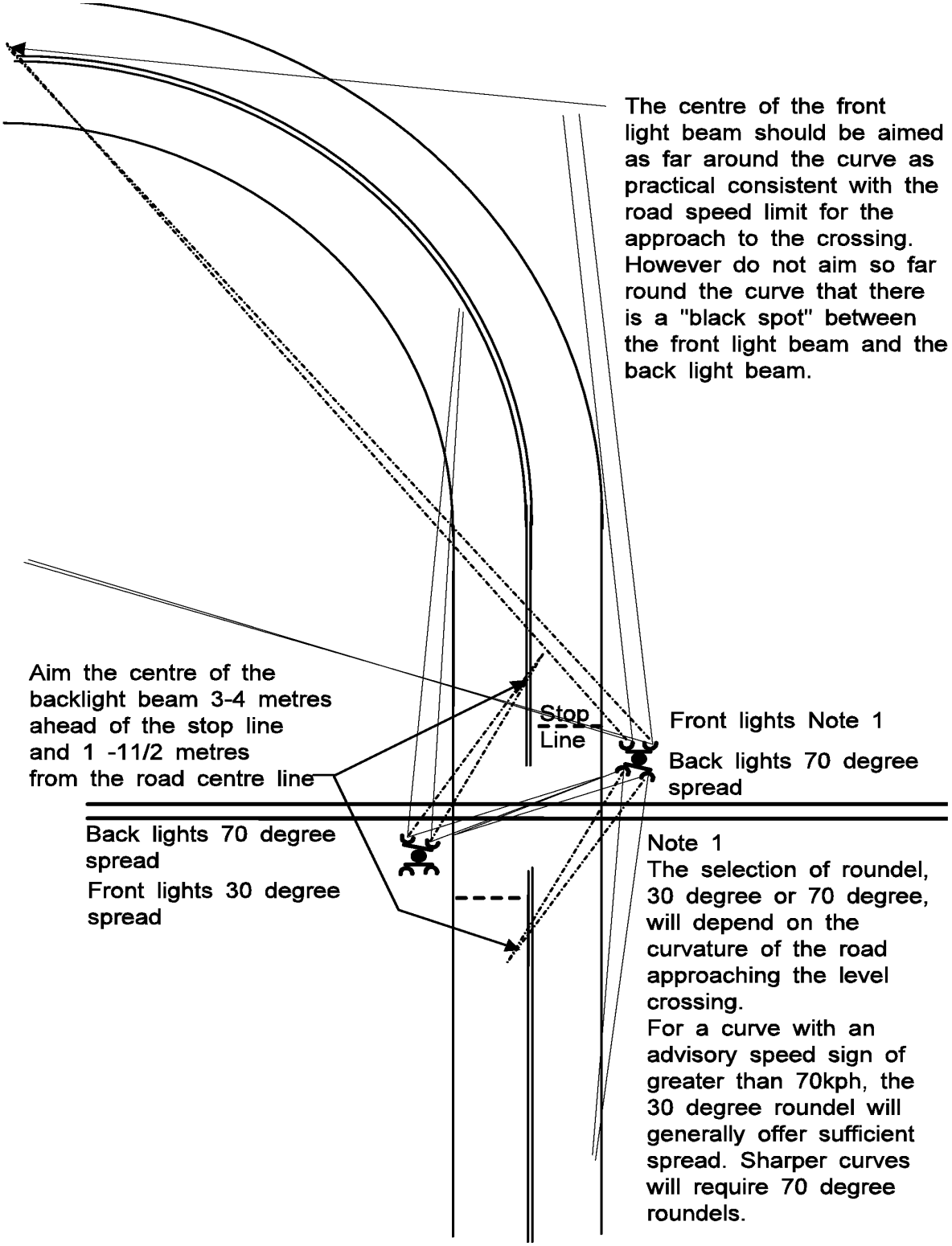
14.2 Figure 5 – Straight Road Approach



14.3 Figure 6 – Left hand Curved Approach

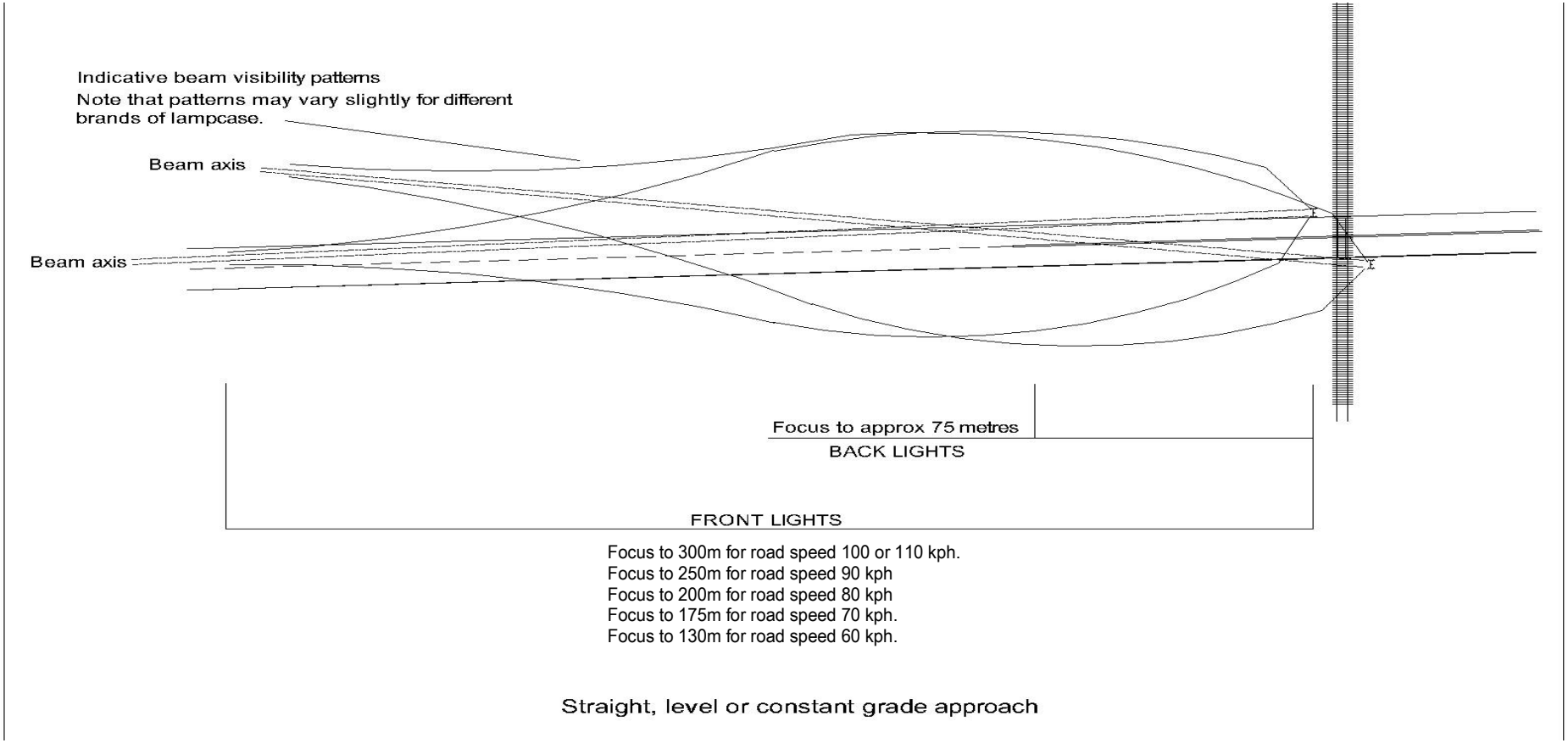


14.4 Figure 7 – Right Hand Curved Approach

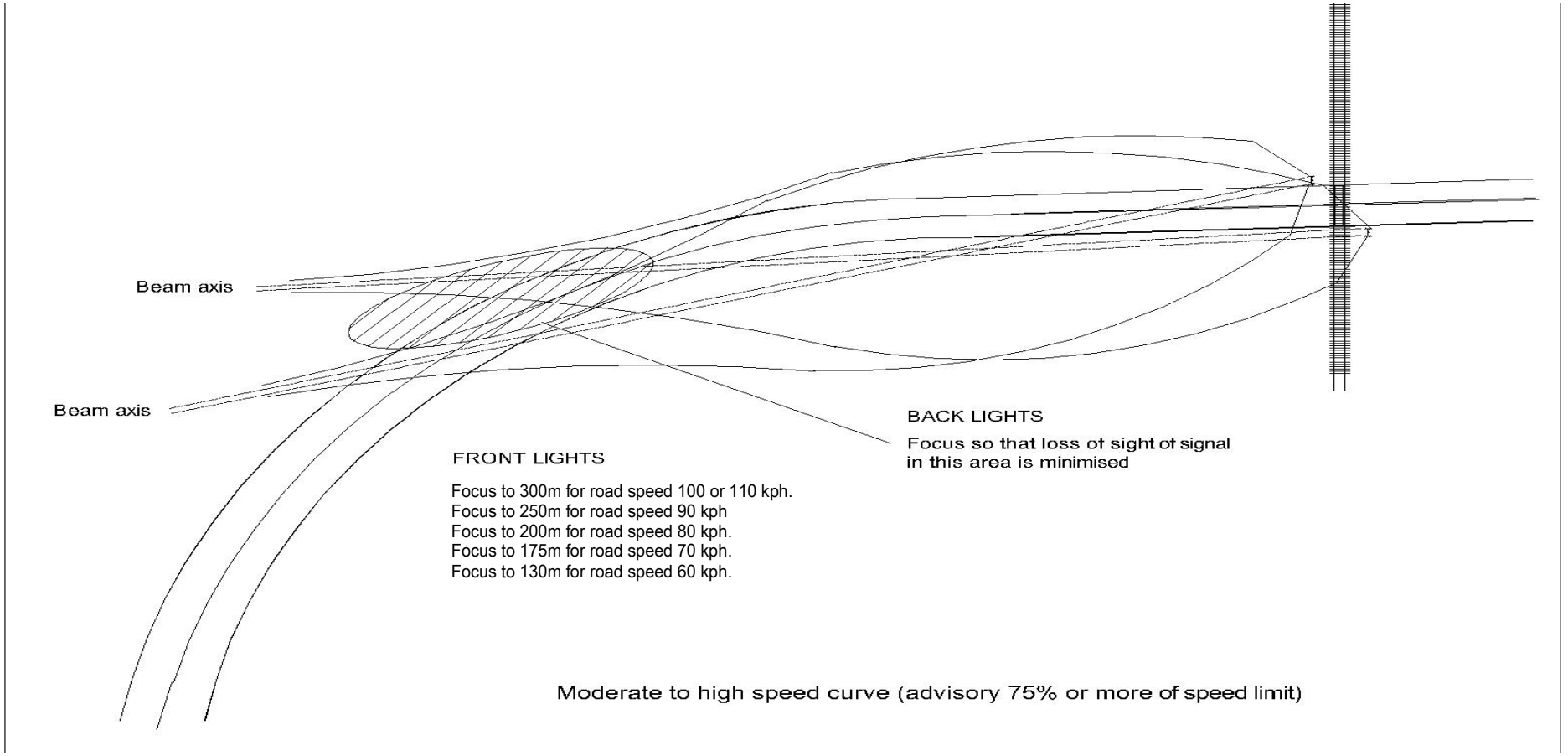


15 Appendix C - LED Flashing Road Traffic Signal Alignment (focusing)

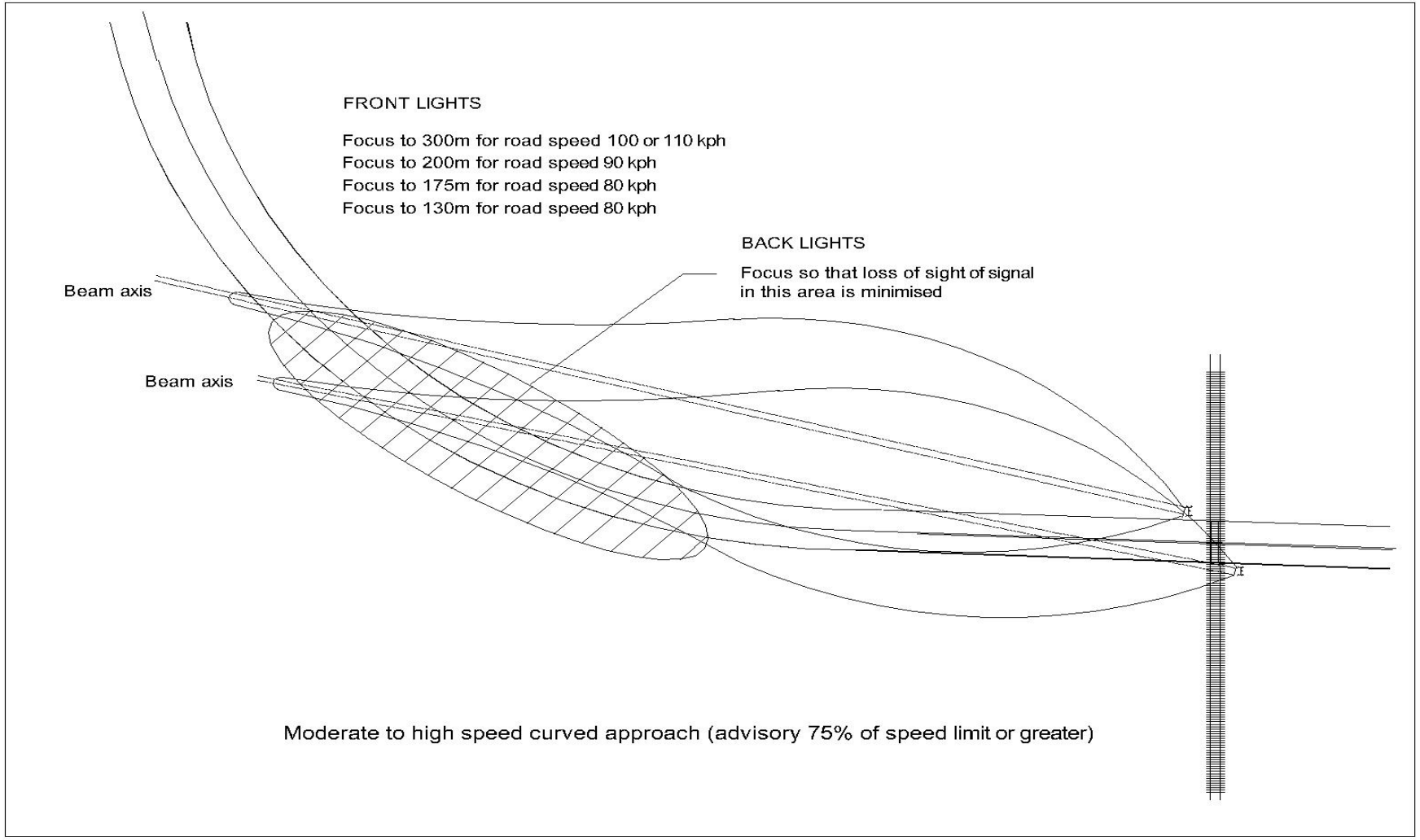
15.1 Figure 8 – LED Flashing Road Traffic Signal Focusing - example 1



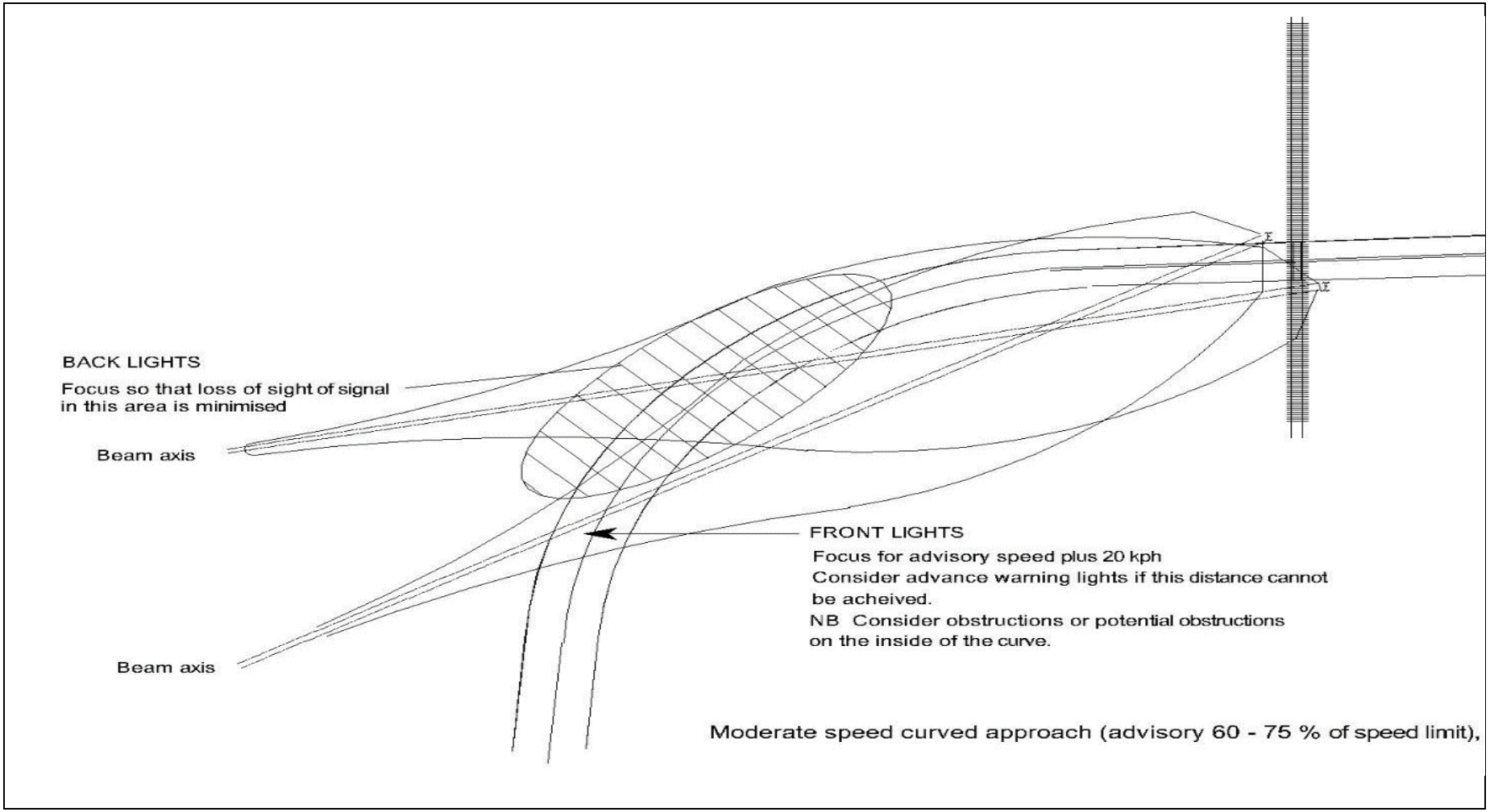
15.2 Figure 9 - LED Flashing Road Traffic Signal– Focusing example 2



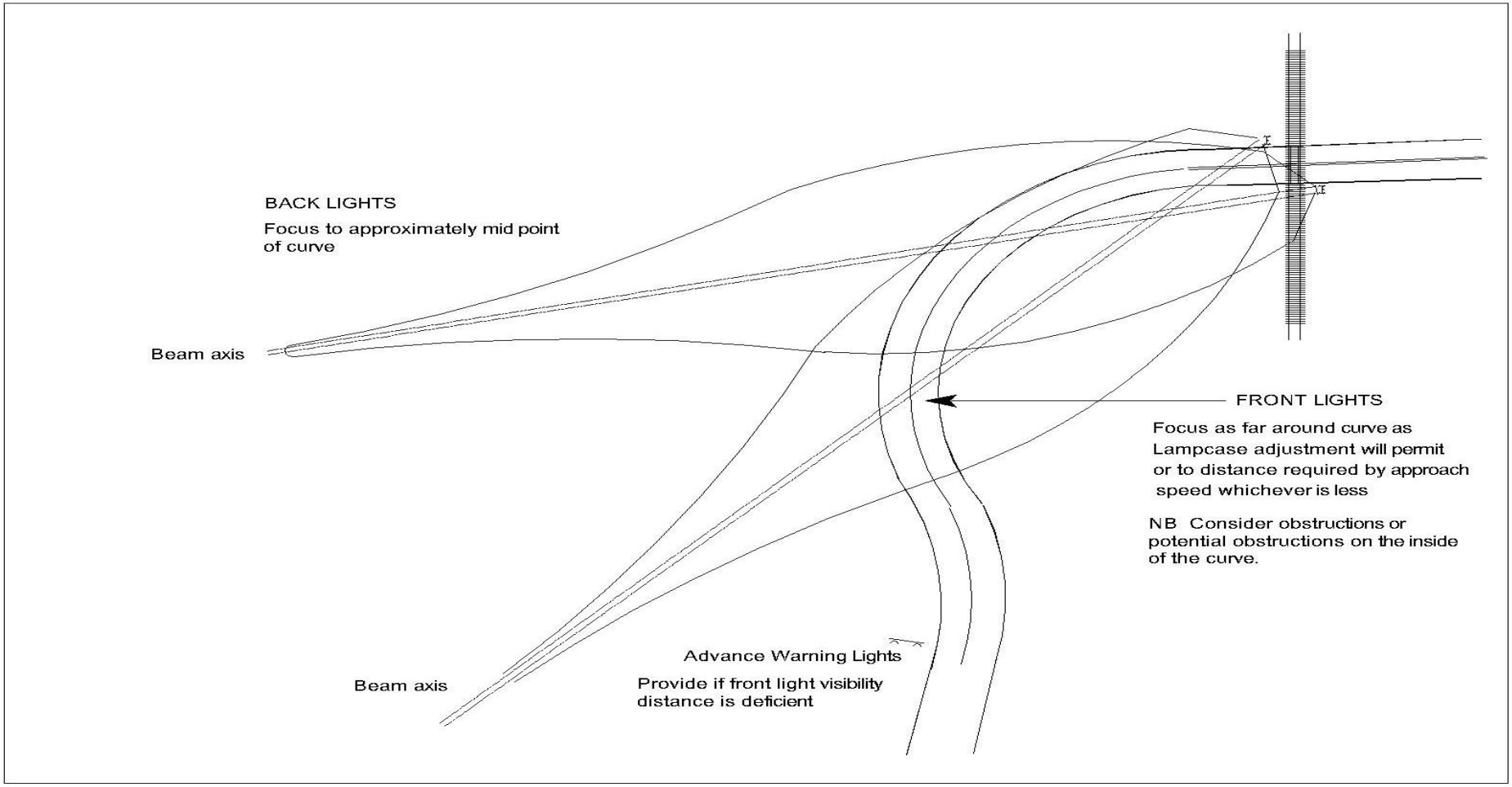
15.3 Figure 10 - LED Flashing Road Traffic Signal – Focusing example 3



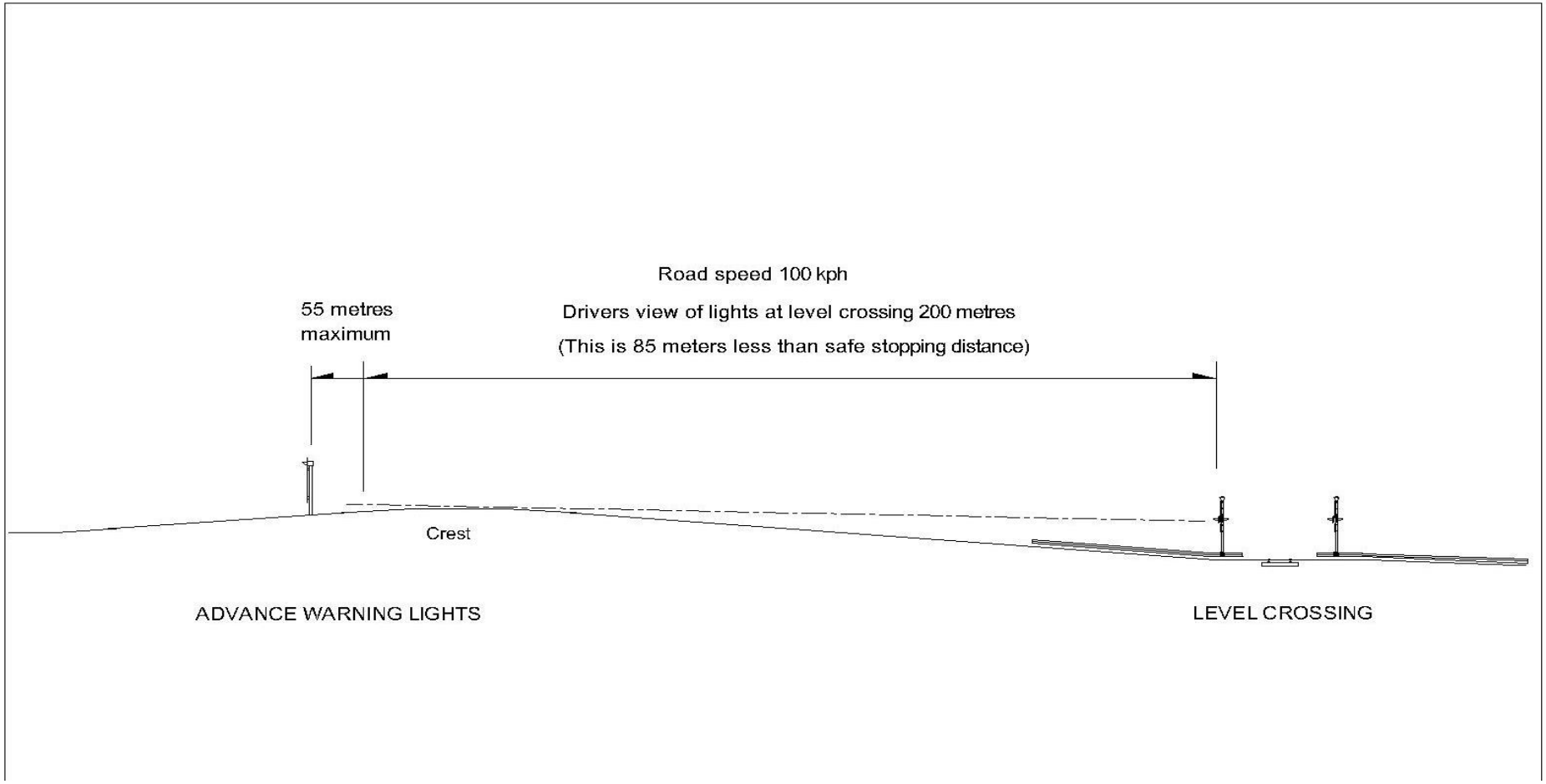
15.4 Figure 11 - LED Flashing Road Traffic Signal – Focusing example 4



15.5 Figure 12 - LED Flashing Road Traffic Signal – Focusing example 5



15.6 Figure 13 - Advance Warning Light Application



16 Appendix D: Alignment (Focusing) of Level Crossing Signals.

Three persons (including one to act as the viewer's lookout for road traffic) are required to align level crossing signals.

The alignment must be carried out in daylight.

For the front lights, the person who is to view the signal shall do so from the distance nominated in Section 2.3.1 Focusing of Level Crossing Lights for the road speed limit applying to the approaches to the level crossing or at the maximum available sighting distance, whichever is less. The viewer should be positioned 1 to 1.2 metres to the left of the road centre line, for two lane roads and approximately one metre to the right of the lane dividing line for four lane roads. (For four lane roads both the left-hand side front lights and the median strip front lights should be aligned to the same point.)

For the backlights, the viewing position should be as shown on the typical situation diagrams in in Section 15 Drawings. (For four lane roads, the median strip back lights (if fitted) should be aligned to the left lane and the opposite side backlights aligned for the right lane.)

For straight road approaches, the level crossing signal lampcase door, on the front lights only, should be opened and the signal aligned directly from the lamp and reflector.

For curved approaches, particularly those sharp enough to require a 70 degree spread lens in the front lights, and for the back lights, the level crossing signals should be aligned with the lampcase door closed.

The person aligning the signal should first approximately align each lampcase to point towards the viewer with the indication beam approximately horizontal.

The lampcases should then be rotated side to side and up and down until the viewer indicates the position of maximum visibility.

With curved road approaches, the viewer should then walk back towards the level crossing checking the visibility of the signals throughout the curve.

If there is significant loss of sight of the signals, then the lampcases will need to be re-aligned to compensate even if this slightly reduces the intensity at the original viewing point.

If the loss of intensity is such that the signals cannot be aligned to provide full coverage from the required sighting distance over the approach to the crossing, then either additional signals at the level crossing are required or pre-warning signals are required.

It is not necessary to make any special provision for the height of the viewer. A standing person's eye level is a reasonable compromise between the eye levels of car and heavy commercial vehicle drivers.