WAKA KOTAHI
NZ TRANSPORT AGENCY

CIVIL AND STRUCTURAL REQUIREMENTS

ITS Design Standard

30 JUNE 2020
1.0

New Zealand Government

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More information
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Contents

1 DOCUMENT CONTROL

1.1 Document information

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1.2 Document owner

Role	ITS Document Review Panel
Organisation	Waka Kotahi

1.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
DD/MM/YY		Design Engineer	Waka Kotahi
		Product Manager	Waka Kotahi
		Asset Manager	Waka Kotahi
		Safety Engineer	Waka Kotahi
		Security Specialist	Waka Kotahi
		Technical Specialist (Technology Operations)	Waka Kotahi
		Procurement Manager	Waka Kotahi
		Journey Manager (Transport Operations)	Waka Kotahi

1.4 Version history

This table shows a record of all changes to this document:

Version	Date	Author	Role and organisation	Reason
0.1	20/09/10	Tom Harris	Senior Design Engineer, WSP Opus	ITS draft specifications issue
0.2	25/01/11	Jamie French Tom Harris	Beca Senior Design Engineer, WSP Opus	AMA specifications review Draft R1
0.3	09/01/12	Bruce Walton Paul Addy	Beca Technical Principal, Transport Technology, WSP Opus	Update following consultation Final R2
0.4	08/03/12	Bruce Walton	Beca	Final R3
0.5	15/03/18	Kevan Fleckney Kirill Yushenko	Waka Kotahi Consultant, Aecom	Additional information provided plus addition of DAS fibre and air-blown fibre Draft R4
0.6	14/05/20	Final Word	Editorial services	Transferring draft document to latest ITS design standard template
0.7	12/05/20	ITS Document Review Panel	Waka Kotahi	Reviewing the document in the new template, resultant edits
1.0	30/06/20	ITS Document Review Panel	Waka Kotahi	Interim draft issued

2 TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of Waka Kotahi
PENDING	The document has been approved and is pending ratification by Waka Kotahi. It can be used for procurement at this status
RATIFIED	The document is an official Waka Kotahi document. Road controlling authorities are obliged to follow a document with this status
RETIRED	The document is obsolete, and/or superseded
AASHTO	American Association of State Highway and Transportation Officials
AS/NZS	Australian and New Zealand standards
AWS	Advanced warning sign
CCTV	Closed-circuit television
CoPTTM	Code of practice for temporary traffic management
EJT	Estimated journey time
EN	European standard
HSiD	Health and safety in design
ISO	International Organization for Standardization
LCS	Lane and carriageway signals
LODMAT	Lowest observed daily mean air temperature
MASH	AASHTO Manual for Assessing Safety Hardware
m/s	Metres per second
NB	Nominal bore
NCHRP	National Cooperative Highway Research Program
PTZ	Pan-tilt-zoom [camera]
RSS	Ramp signalling system
SHGDM	State highway geometric design manual
TTM	Temporary traffic management
VMS	Variable message sign
VMSL	Variable mandatory speed limit

3 OVERVIEW AND OUTCOMES

This section defines the operational outcomes for intelligent transport systems with respect to the transport network.

3.1 ITS design standard definition

Design assurance is delivered through a series of design standards. The standards ensure road network level operational outcomes and design for safety, security and maintainability are accounted for in solutions being delivered to Waka Kotahi. Design standards address risks typically generated at the front end of roading or infrastructure projects. Their objective is to ensure solutions address the correct operational need and solutions are fit for purpose.

3.2 System overview

To be defined.

3.2.1 System definition

Civil and structural deals with the components required to support the installation of ITS assets. All ITS assets will require some form of support to hold them in place, or a suitable base platform on which to rest.

3.2.2 System class

010 Civil infrastructure.

3.3 Scope

The purpose of this document is to specify the requirements for support structures and associated foundations for ITS equipment and systems design and installation.

This design standard covers the minimum requirements for installation of structures and their associated foundations for the following roadside ITS equipment installed as a part of Waka Kotahi projects:

- roadside cabinet foundation
- closed-circuit television (CCTV)
- variable message signs (VMS)
- variable mandatory speed limit (VMSL) signs
- lane and carriageway signals (LCS)
- advanced warning signs (AWS) and traffic signal gantries as a part of ramp signalling systems (RSS).

For the above roadside ITS equipment, this document will cover:

- expected standards they comply with
- support structures, their types and options
- support structure foundation guidance
- installation options — lateral position, heights and offsets

- maintenance access requirements.

3.4 Applicable legislation

To be defined.

3.5 Outcomes

To be defined.

3.5.1 Operational

To be defined.

3.5.2 For road users

To be defined.

3.5.3 For road controlling authorities

To be defined.

4 DESIGN FOR OPERATION

This section defines the functionality required to achieve successful operation of the intelligent transport system.

4.1 General

The civil and motorway site construction works shall be carried out in accordance with Waka Kotahi specifications, including bituminous materials, concrete and earthworks/fill materials classification and testing.

The maintenance access area shall be sufficient to provide a safe working distance from the highway traffic lanes and shall be protected by road safety barriers as required.

The maintenance access shall be paved (sealed or Grasscrete™) and shall not be constructed with loose material in order to avoid vehicles bringing it onto the highway.

A safe (from slips and trips) access path shall be provided to the following (but not limited to) ITS roadside equipment: roadside cabinets, CCTV poles, VMS gantries and poles, LCS gantries, RSS traffic signal gantries and AWS poles from the maintenance bay.

All new pavement areas shall be designed to provide free-draining finished surfaces. Where new works butt onto existing pavements, the new lines and levels shall match the existing.

The contractor shall be responsible for ensuring that safety barriers or guardrails are provided at all required locations in accordance with the latest Waka Kotahi policies, standards and guidelines. Refer to section 5.2.1 in this document for safety barrier requirements.

Where there is an existing concrete barrier which needs to be extended for the ITS-related works, the new barrier shall be of the same profile as existing.

Disposal of stormwater runoff shall be designed to comply with Waka Kotahi and relevant local authority requirements.

The area surrounding ITS roadside equipment shall where necessary be contoured to ensure that there is no trip hazard at the interface with the new asset and that there is no ponding of surface runoff water. Earth areas shall have topsoil reapplied. Grassing or planting shall be in agreement with the Waka Kotahi-appointed maintenance contractor.

4.2 Support structures

Gantry structures designed for LCS/VMSL/VMS shall be galvanised steel truss and shall include the following:

- steel plate section column detail to prevent the general public from climbing the structure
- access ladder with enclosed safety hoops (possum tube) and padlocked security gate on the leg of the gantry closest to the maintenance access (this does not necessarily have to be on the same side of the

road that the asset is controlling if a full span gantry is used). See the latest versions of ITS standard drawings.

- 2m-high gantry truss with full-width checker plate walkway extending from the access ladder across the width of the VMS or to a point 1m past the far side of the furthest lane signal unit
- support frames allowing the LCS/VMSL/VMS to be vertically and horizontally aligned to maximise viewing distance
- handrails around the full extent of the walkway and the ends of the LCS/VMSL/VMS support frame
- 200mm by 50mm slotted holes shall be provided in the traffic face of both gantry shoulder leg columns above the base of the leg and above the truss bottom chord for cable access
- a suitable mesh shall be included on each side to prevent tools and small parts from dropping through to the ground or live traffic below.

The gantry truss shall be level across the carriageway and the minimum clearance to the lowest point of the gantry structure or any part of its attached LCS/VMSL/VMS equipment or attaching frames (whichever is lower) shall be at least 6m above the highest point of the carriageway below. For locations where the LCS/VMSL equipment share a gantry with other display equipment such as VMS or static signs, the VMS or static sign shall be mounted above the LCS/VMSL.

Load calculations for the gantry structures shall include an allowance for equipment weight plus 25 per cent to allow for future alterations. The design shall in particular comply with the requirements of AS/NZS 1170, NZS 3101.1&2:2006 Concrete structures standard and NZS 3404 Parts 1 and 2:1997 Steel structures standard.

Walkways shall be provided with a minimum of three safety rails on each side at 450mm, 900mm and 1350mm above the walking surface in compliance with the NZ Building Code. Access to and along this walkway shall not be obstructed by a truss diagonal bracing member at or within one truss section of the shoulder leg. The design of the asset mounting structures to the gantry shall ensure that the asset enclosure doors are not obstructed by any section of the platform or fittings and are capable of being fully opened to at least 90 degrees.

Walkways shall be fitted with integral kickplates at least 150mm high to completely surround the walkway (except at the ladder access). Drainage holes shall be provided as required but shall be fitted with stainless-steel mesh.

Standard designs for truss and cantilever gantries are available in the latest versions of ITS standard drawings range 000-0000-0-7104-50-RX to 000-0000-0-7104-73-RX.

Motorway VMS suppliers may offer enclosures which fully enclose the hardware and any maintenance staff. Such enclosures will be accessed by a single door at the access ladder end. This has the advantage of allowing maintenance in all weather conditions and fully mitigating any risk of dropped items. For this design, the support structure will only require the access ladder and cage and possibly a small platform.
All steel components shall be hot-dip galvanised.

4.3 Support structure performance

4.3.1 Design drawings

Design drawings for the supporting structures shall be submitted to the Transport's Agency's Engineer for comment within three weeks from the start of the contract prior to fabrication and construction.

The design for the supporting structures shall comply with, but not be limited to, the relevant standards as listed under section 10 References in this document.

4.3.2 Protective coatings

All steel components, including VMS, LCS and RSS traffic signal gantry structures, CCTV poles, AWS and estimated journey time (EJT) VMS support poles and brackets shall be hot-dip galvanised in line with the relevant standards as listed under section 10 References in this document).

The protective coatings shall be either:

- zinc with a dry film build-up of 0.350mm or
- hot-dip galvanised: the minimum thickness of zinc coating shall be in accordance with table 1 of 2 of AS/NZS 4680:2006 Hot-dip galvanised (zinc) coatings on fabricated ferrous articles

All structural steel used for VMS, LCS and RSS traffic signal gantry structures, CCTV poles and AWS support poles and brackets shall have protective coating suitable for the specific environment where gantries, poles and brackets are installed.

4.3.3 Excavation and construction material

Excavation and backfilling will be in accordance with the relevant Waka Kotahi standard specifications.

Certain types of foundation require formwork, such as gantry foundations and cabinet pads. Where foundations do not require formwork, the concrete shall be poured against undisturbed surfaces free from loose material. Any unsuitable material shall be excavated and backfilled with blinding concrete, as directed by the Waka Kotahi Engineer. The final excavated surfaces shall be inspected and approved by the engineer before the work proceeds. If excessive overbreak does occur, either temporary or permanent formwork may be used to form the foundation. The overbreak shall then be backfilled with 10 MPa concrete or approved granular material to ensure no voids are present between the outside face of the foundations and the ground.

Care shall be taken to avoid disturbance of adjacent foundation material in the median strip and shoulders.

Granular backfill shall be compacted in 150mm layers using approved hand-operated mechanical tamping equipment to the satisfaction of the Waka Kotahi Engineer, and to a standard at least equivalent to that prior to excavation.

Concrete specification (including reinforcement and formwork) and testing shall be in accordance with the relevant Waka Kotahi standard specification.

4.3.4 Structure holding-down bolts

The gantry or pole holding-down bolts shall be fabricated from high-tensile plain round steel bars with a minimum strength of 830 MPa. Other steelwork shall comply with AS 1204, grade 250. Steel shall be completely free from defects such as laminations, rust or pitting.

The holding-down bolt assemblies shall be supplied with nuts, lock nut washers and levelling nuts complying with AS 1111, commercial grade bolts.

The holding-down bolt assemblies and nuts, lock nut washers and levelling nuts shall be hot-dip galvanised in accordance with T-CES 306. Bolts and nuts shall be centrifuged or otherwise treated, on removal from the galvanising bath, to remove any excess molten zinc and to leave clean threads. Nuts shall be re-tapped to size after galvanising.

On completion of the gantry foundation construction, all the holding-down bolts shall be completely wrapped in cold-applied anticorrosion and sealing tape based on a synthetic fabric, impregnated and coated with a neutral petrolatum compound.

4.3.5 Holding-down bolt templates

The holding-down bolt assemblies shall be supplied 10mm steel plate templates for setting out the top of the bolts. The templates shall be individually numbered to identify each holding-down bolt assembly (see figure 1, below). Heavy-duty ply may be used for setting the holding-down bolt and duct entry point for CCTV pole foundations (see figures 4 and 5, section 4.6.3 in this document).

On completion of the gantry foundation construction, the holding-down bolt templates shall be delivered to the Waka Kotahi Engineer with a plan indicating the locations on the gantry foundations and which template was used.

4.3.6 Holding-down bolt setting out

The holding-down bolt assembly shall be positioned and aligned to the following tolerances:

- Position: Shall be (distance to a common reference line) ±20mm.
- Level variation of top face: Bolt types shall be concrete in place to the levels shown ±5mm, with all bolts at the same level ±3mm and correct location relative to any other bolt ±2mm.
- Orientation of bolt groups or base stubs: ±0.5 degrees.

The contractor shall:

- make use of steel templates for the precise positioning of the holding-down bolts for the gantry legs
- bear the cost of any remedial work that is required, if the assembly is placed in the wrong position or moves during the concreting operations.

After completion of concrete placing, the bolt threads shall be cleaned and the nuts run up the full length of thread.

Figure 1. Cantilever gantry foundation under construction with steel templates for the holding-down bolts, the duct access and the spacing of the gantry legs.

4.4 Highway lighting

The contractor shall ensure that the ITS civil and motorway siteworks and structures along the highway corridor do not create or induce lighting levels to change to be below the standard requirements for lighting levels on the highway. ITS design shall be closely coordinated with signage and highway lighting designs.

4.5 Roadside cabinets

4.5.1 Roadside cabinet plinths and aprons

Roadside cabinets shall be supported on reinforced concrete plinths with a minimum thickness of 300mm and plan dimensions matching the external dimensions of the roadside cabinet.

At all roadside cabinets, concrete aprons having a thickness of 100mm and 1m in width shall be constructed around all four sides of the cabinet plinth.

The surface of the concrete apron adjacent to the cabinet shall be 20mm below the inside of the cabinet plinth base, and the apron shall have a fall of 30mm towards the outer edges to shed stormwater runoff.

The apron concrete surface shall be lightly broomed in a transverse direction to provide a non-slip finish.

The area surrounding the cabinets shall, if necessary, be contoured to ensure there is no ponding of surface runoff water and shall be topsoiled, grassed and finished in a workmanlike manner, in accordance with the contract specification.

Cabinets shall be orientated so that the personnel working at the front of the cabinet are able to see oncoming traffic. Cabinet doors shall not open into an adjacent cycleway, narrow footpath or above a steep slope, because doing so creates a safety hazard for users and maintenance personnel. If a cabinet is to be positioned within 2m from a steep slope (more than 1 in 3 [33 per cent gradient] – angle to be agreed by a safety engineer), a suitable fence or barrier shall be installed.

Figure 2. Lowering CCTV pole with communications cabinet and ramp signal cabinet atop a retaining wall with safety rails and a kickboard.

4.5.2 Roadside cabinet duct connections

Each roadside cabinet plinth shall have six 100mm nominal bore (NB) long-radius bend ducts (manufactured to AS/NZS 61386 Conduit systems for cable management) terminated flush with the plinth top surface and extending to the perimeter of the cabinet apron where there shall be 600mm cover over the duct.

The cable ducts to the cabinet shall be connected to the bends and the spare bends should be capped at their outer ends.

Where loop feeder cable ducts are designed to be 50mm nominal more (manufactured to AS/NZS 61386 Conduit systems for cable management), they shall terminate at the nearest chamber to the cabinet from where the cabling will go through one of the six 100mm ducts mentioned above.

The ducting shall be supplied and installed in accordance with the latest version of ITS design standard: Ducts.

4.6 Closed-circuit television

4.6.1 Pole types

Three types of CCTV support poles will be accepted by Waka Kotahi:

- mid-hinged folding pole
- wind-down pole
- rigid pole.

Some CCTV cameras may be mounted on a VMS or LCS gantry structure by means of a short pole. A suitably robust pole may be attached to the structure and shall be constructed in such a way that the camera may be safely retrieved or maintained without the need to close the road beneath.

Health and safety in design (HSiD) principles stipulate that elimination of risk is the highest priority. Working at height is one of the most significant safety concerns during construction and maintenance and therefore should be eliminated. Therefore, use of a rigid CCTV support pole of any type would need extenuating circumstances to permit its use. Furthermore, rigid poles frequently require temporary traffic management

(TTM) which brings further hazard for workers and the public. Elimination of these hazards will also be required.

Where the natural ground contour requires a pole taller than 15m, the pole and its associated foundation shall be designed to account for any additional loading and specific consideration shall be given to maintenance access.

The approval of the Waka Kotahi Design Engineer shall be obtained for the location and maintenance access provisions for any pole taller than 15m.

4.6.2 Pole performance

The supporting structures for all CCTV installations shall be smooth-sided vertical poles meeting the details of this specification and shall be similar in appearance to existing installations. Poles are typically round, octagonal or hexadecagonal in cross section.

The CCTV poles shall be independent units and shall be detachable from the supporting structure.

CCTV poles must comply with the following requirements:

- The pole and foundation shall be designed to AS/NZS 1170.2:2011 to support the headload of lightning system elements, pan-tilt-zoom (PTZ) CCTV and IP web camera units, including brackets and other assembly associated equipment.
- Total height of any CCTV pole assembly installation (including any aerials, lightning system elements, or any other hardware) shall not exceed 20m above grade due to a district plan restriction (unless a special consent is given).
- The supporting pole shall have sufficient internal clearance and provision for cables to be run internally up the length of the pole.
- Hinged folding poles shall have a protection system for the cables at the hinge location.
- Hinged folding poles shall be proportioned and balanced with the installation of the CCTV units so that the hinged portion of the pole will swing down to the base of the pole under its own weight. The pole balancing weighting system must be simply adjustable to allow for future addition or removal of equipment.
- Hinged folding poles shall be securely closed when raised.
- A supporting chain or steel cable shall be installed inside the pole to support communications and power cables feeding to equipment installed on the pole.
- The pole shall be sufficiently rigid to minimise vibration in windy conditions.
- For wind-down poles, the following points apply:
- The camera-mounting carriage which is lowered with the camera shall be capable of being locked at the top of the pole so that tension can be taken off the main cable. Should a cable fail, the camera will stay at the top.
- The pole design shall allow a single PTZ camera to be mounted at the top without losing 360 degree horizontal visibility. A small area of lost visibility looking down caused by the pole-top mechanism and camera carriage shall be permitted.
- The camera mounting assembly (outreach or upreach) shall be rigid and free from unnecessary vibration in windy and gusty conditions.

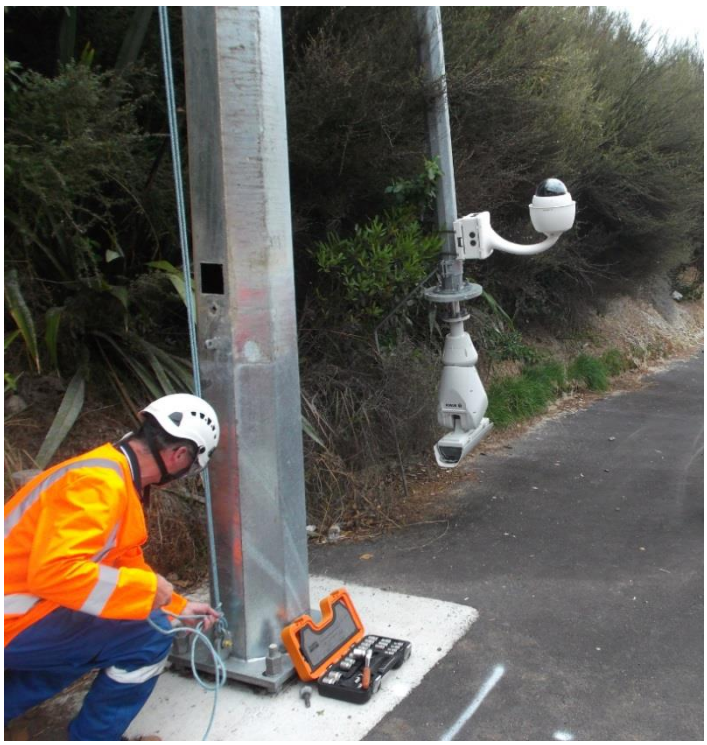


Figure 3. Safe CCTV camera maintenance at ground level.

4.6.3 CCTV pole foundations

The standard CCTV pole foundation shall be either a galvanised steel pole stub with a flange onto which the CCTV support pole is bolted, or a steel foundation cage with the holding-down bolts built in. The pole foundation stub shall be supplied to match the CCTV pole. If the CCTV pole is not supplied with a stub, the CCTV pole foundation shall be constructed using a cage. The design of the cage shall be produced to meet site requirements. For holding-down bolts assembly, refer to sections 4.3.4 Structure holding-down bolts, 4.3.5 Holding-down bolt templates and 4.3.6 Holding-down bolt setting out in this document.

The cable duct from the CCTV pole to the roadside control cabinet shall be a 100mm NB extra polyethylene or PVC-U duct (complying with AS/NZS 61386 Conduit systems for cable management) and shall have a formed long-radius bend (at least 600mm) into the CCTV pole foundation stub (this duct will carry power and communication cables and will be connected to the roadside control cabinet). See the latest version of ITS standard drawing 000-0000-0-7104-46-RX.

The ducting shall be supplied and installed in accordance with the latest version of ITS design standard: Ducts.

The supply and construction of concrete for the CCTV pole foundation shall comply with T-CES 101.
The concrete shall have a minimum compressive strength of 25 MPa after 28 days.

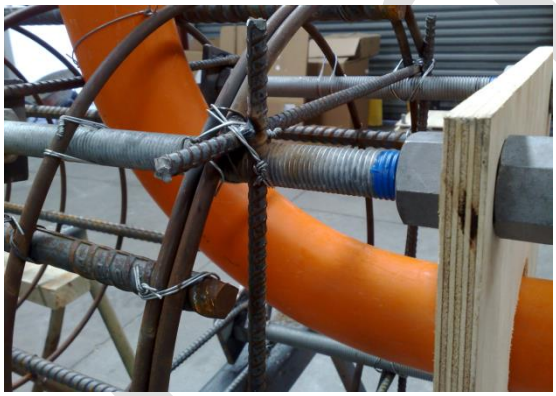
The CCTV pole stubs shall be positioned and aligned to the following tolerances:

- level of top face: ±3mm
- vertical orientation of pole stub: ±0.1 degrees.

The CCTV pole foundation holding-down bolts or pole stub bolt holes shall be aligned so that the hinged folding pole is aligned and located to swing down parallel to and clear of any carriageway and clear of the site roadside control cabinet.

The roadside cabinet shall be positioned as close as practicable to the associated CCTV pole. This will allow minimising the length of cabling and reducing total required combined maintenance area around the CCTV pole and the roadside cabinet.

The requirements for the supply and testing of a CCTV camera shall be in accordance with the latest version of ITS delivery specification: CCTV. The requirements for the design and commissioning of a CCTV camera shall be in accordance with the latest version of ITS design standard: CCTV.



Figures 4 and 5. CCTV pole foundation cages undergoing fabrication. Note ply template for the holding down bolts and the duct entry.

4.7 Variable message signs

4.7.1 Support structure types

Motorway VMS and regional VMS types A, B, C and D shall, depending on the type and location of the VMS, be one of the following types:

- gantry (truss portal or truss cantilever)
- single-post mounted, including cantilever
- dual-post mounted.

See the latest version of ITS delivery specification: VMS – fixed (Section 7: Appendix A – Waka Kotahi VMS types).

4.7.2 EJT VMS/AWS support structure type

The type of EJT VMS/AWS support pole and bracket will vary dependent on site conditions and installation restraints as detailed in the design. See the latest versions ITS standard drawings 000-0000-0-7104-20-RX, 000-0000-0-7104-21-RX, 000-0000-0-7104-22-RX and 000-0000-0-7104-23-RX.

- The type of pole used for mounting EJT VMS/AWS shall be dependent on the conditions of the site and the installation constraints.
- Standard EJT VMS/AWS pole shall be 3.9m hot-dip galvanised steel, enabling a 2.5m ground clearance after installation. The AWS shall not be mounted above a carriageway.

- For special conditions, where viewing height is needed or ground conditions dictate, a 4.9m hot-dip galvanised steel pole shall be used instead, enabling a 3.5m ground clearance after installation.
- The F type bracket shall be used over walkways or where the installation is in close proximity to the road.
- The C type bracket shall be used where the sign is centrally mounted on the pole. It is used in standard installation environments.

4.7.3 VMS on motorway and expressways

Only motorway VMS shall be installed on motorways and expressways.

A variable font height-capable type A regional VMS may only be installed on motorways or expressways for secondary messaging purposes, such as for the provision of journey time information.

Types B, C and D regional VMS shall not be installed on motorways or expressways due to their limited font size and message delivery capability.

Motorway VMS (and regional type A VMS where used) shall always be mounted above the carriageway.

There are standard designs (see the latest versions of ITS standard drawings range 000-0000-0-7104-50-RX to 000-0000-0-7104-73-RX) for motorway and expressway gantry support structures, which shall be adjusted to take into account variations in span or outreach, weight and size of the proposed sign.

It is mandatory that a VMS located on a motorway or expressway is mounted over the carriageway on a truss or cantilever gantry structure. In certain circumstances a VMS can be mounted on a bridge (though it is outside the scope of the standard). It is preferred that the sign is positioned centrally over the carriageway it covers.

VMS can be side-mounted for single lane carriageway, and must be mounted overhead for multi-lane carriageways.

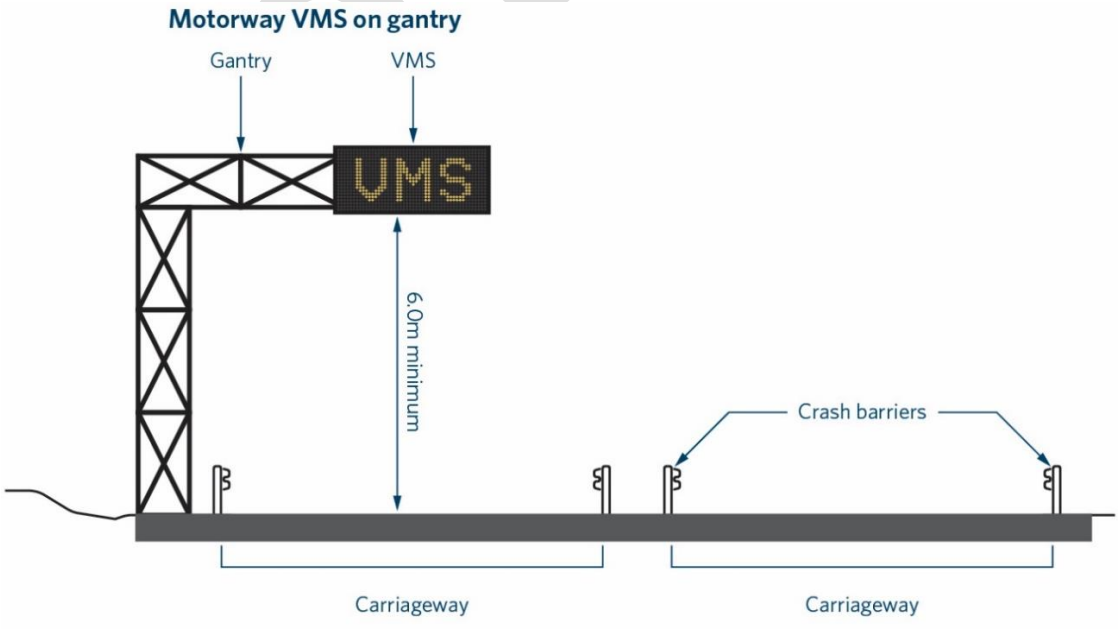


Figure 6: Example of a cantilever gantry.

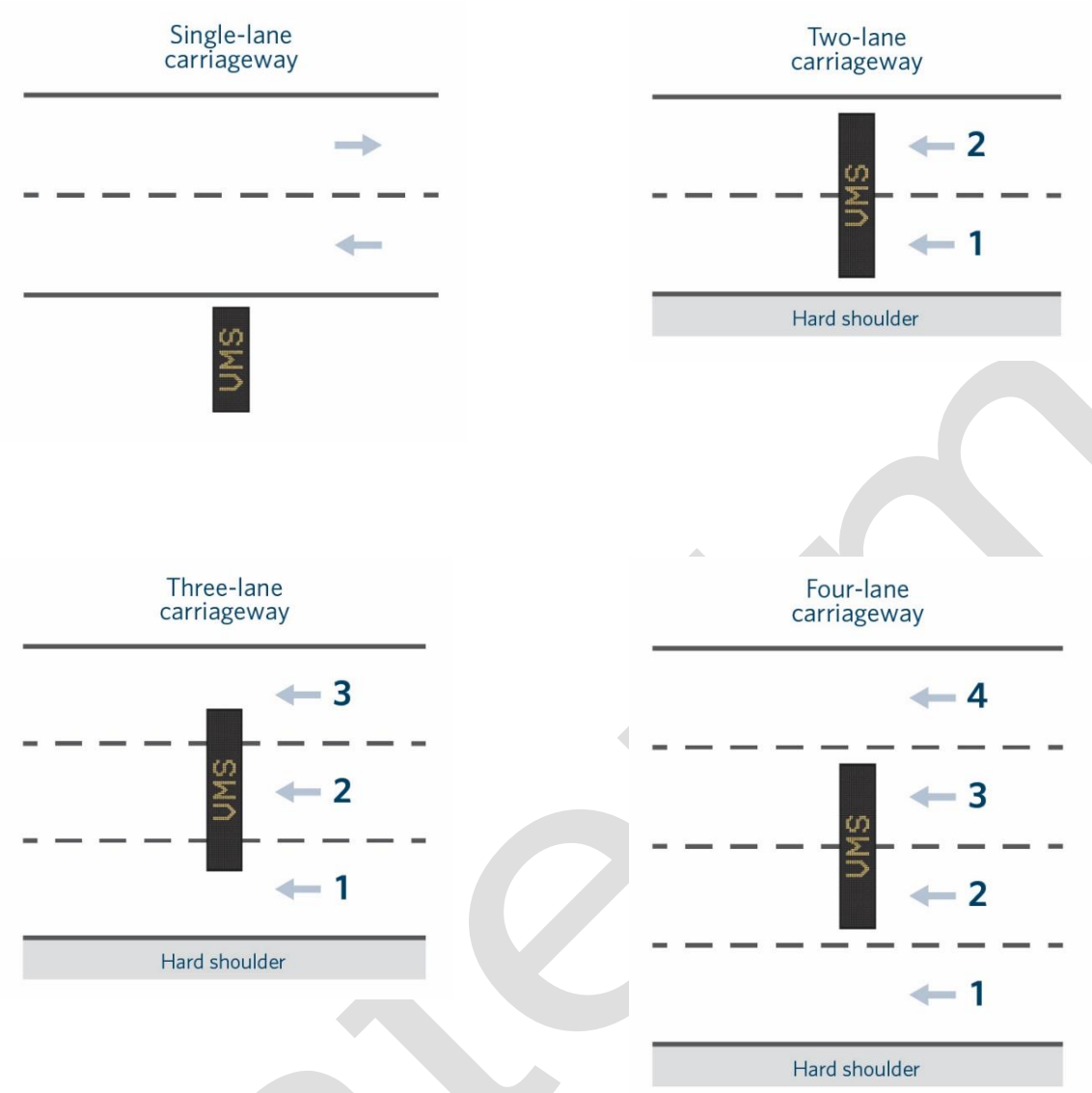


Figure 7. Example of typical overhead view of positioning for VMS above motorway or expressway depending on number of lanes.

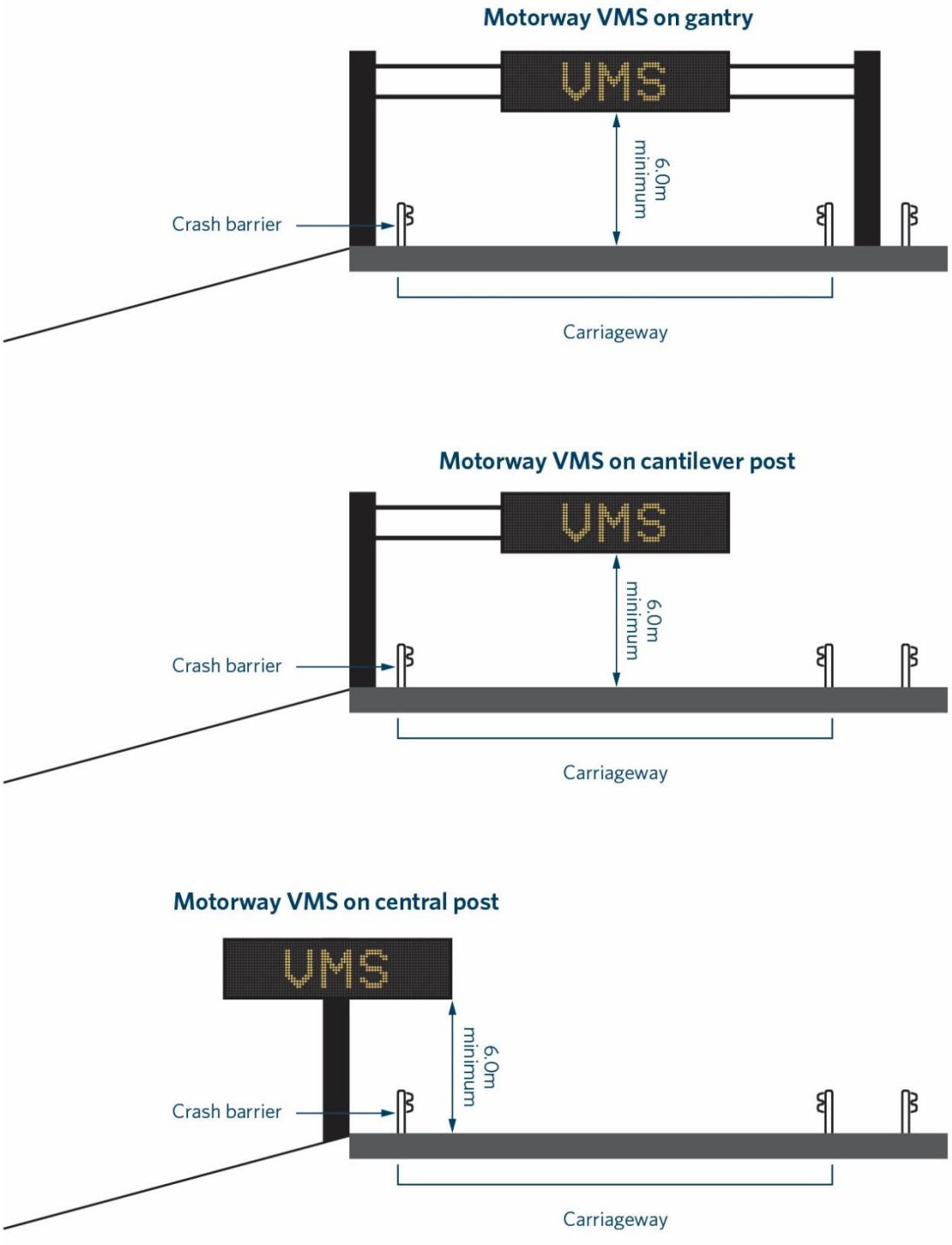


Figure 8. Example of typical cross-sectional view of mounting options for motorway and expressway VMS.

4.7.4 VMS on roads other than motorways and expressways

Standard solutions are generic standardised designs for regional VMS, where neither the sign support system nor the foundation requires further specific engineering design. Standard solutions are provided for:

- Two-post support structures for regional VMS types A, B, C, D. See the latest versions of ITS standard drawings 000-0000-0-7104-75-RX, 000-0000-0-7104-76-RX, 000-0000-0-7104-77-RX and 000-0000-0-7104-78-RX.

- Single post, centre-mounted support structures for regional VMS types A, B, C, D. These standard solutions allow for offsets of the supporting pole from the centre of the sign to suit the particular site circumstances, up to the dimension limits given on the drawings.
- Single post, rotating-flange support structures for regional VMS types C, D. These standard solutions are for constrained sites. The VMS can be rotated on the support structure to provide access for planned and reactive servicing.
- Standard support structure designs are available in the latest versions of ITS standard drawings range 000-0000-0-7104-75-RX to 000-0000-0-7104-85-RX.

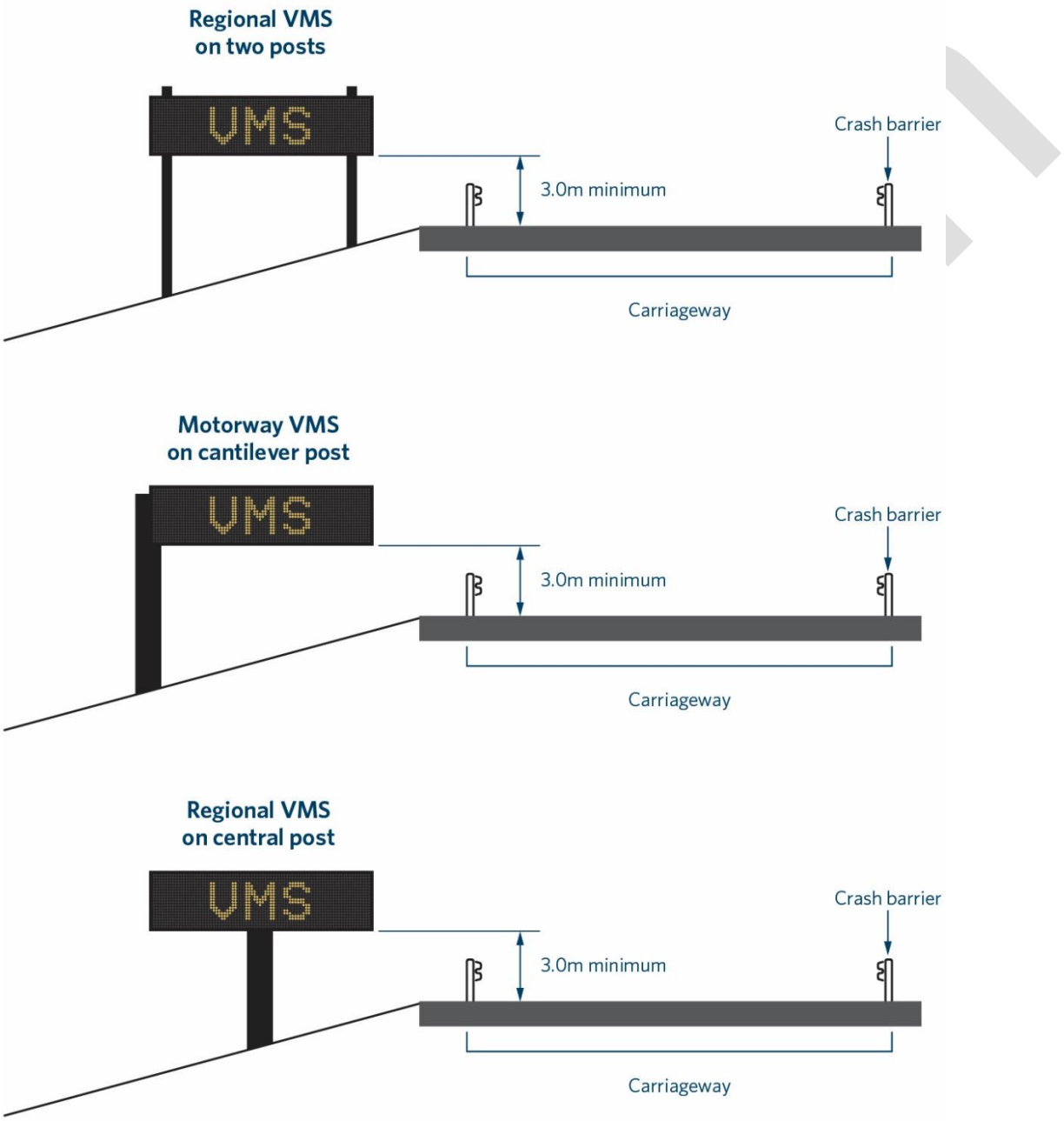


Figure 9. Example of typical cross-sectional view of mounting options for regional VMS on at-grade highways.

Where the proposed sign and foundation soil conditions meet the standard design criteria, a ‘standard solution’ sign support structure and foundation detail can be used for regional VMS.

Where the following requirements are met, a standard solution VMS support structure may be used and no specific engineering design is required.

4.7.5 Foundation conditions for regional VMS

Before adopting a standard solution, site investigations shall be completed to confirm that the foundation soil meets the following minimum soil property requirements:

- For non-cohesive soils (sands/gravels) angle of internal friction (Φ) ≥25 degrees, and soil unit weight of 16 kN/m^3, for the dual-post mounted signs
- For non-cohesive soils (sands/gravels) angle of internal friction (Φ) ≥33 degrees, and soil unit weight of 18 kN/m^3, for the single-post centre-mounted signs
- For cohesive soils (clay) a cohesion (c) value of at least 50kPa
- The groundwater level must be at or below the base of the footing.

4.7.6 Face area of VMS sign enclosure

The standard solutions may only be used for signs that conform to the range of dimensions in the current version of ITS delivery specification: VMS – fixed.

Note: The face panel dimensions must include the bezel, as the wind-loading calculations are based on the total face area.

4.7.7 VMS sign mounting height

When a regional VMS is positioned alongside a state highway, the mounting height of standard solution signs, measured from carriageway level to the bottom edge of the enclosure, on flat ground shall be a minimum of 3m.

However, a VMS sign mounted in this position alongside a road with two or more unidirectional lanes will be obscured by large vehicles travelling in the left lane, from traffic in the right lane, which will result in an important message being missed. This can have safety implications. Therefore, where a sign is located on a carriageway with two or more lanes in the same direction, such as an expressway or motorway, the sign shall be mounted above the carriageway with a minimum height clearance of 6m from the highest point of the road surface to the lowest point of the sign or sign support structure. More clearance will be required where the sign is located on an over-dimension route.

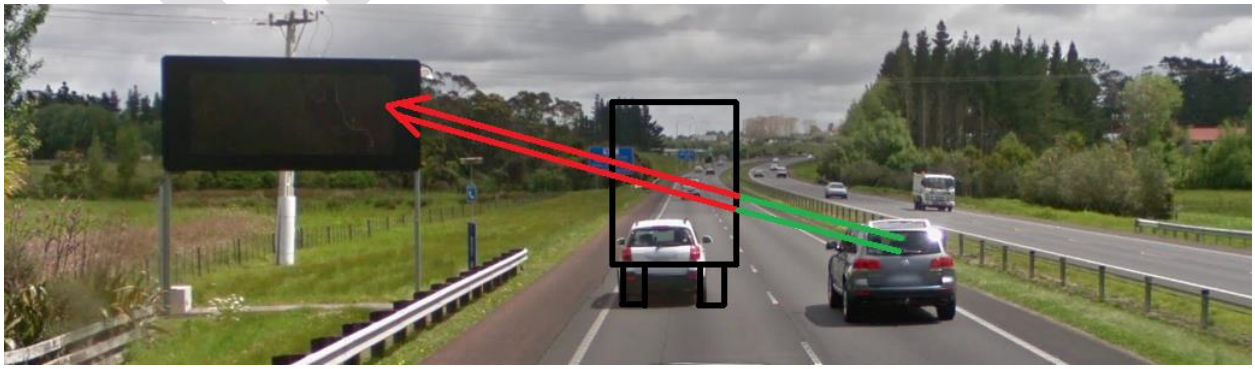


Figure 10. Regional VMS on a motorway. Positioning a VMS to the side of a motorway or expressway with more than one unidirectional lane can result in it being obscured by large vehicles in the left lane, as illustrated here by the truck/coach outline superimposed over a car.

4.7.8 VMS sign mounting lateral position

The designer shall ensure there is an appropriate offset from the edge of the sign closest to the carriageway to the rear face of the barrier, depending on the barrier type, deflection and height. This is to ensure:

- safety requirements are met when servicing from a ladder
- vandalism is minimised
- design wind-loading requirements can be met.

4.7.9 VMS site design wind speed

Site design wind speed for standard solution signs, determined in accordance with AS/NZS 1170.2:2011, shall not exceed 4m/s.

4.7.10 Structure importance level

The standard solution sign 'structure importance level' (refer to AS/NZS 1170) shall be:

- category 3 for signs greater than 12m^2 (regional VMS are usually smaller than this, but become category 3 if they are located over the carriageway)
- category 2 for signs between 4.7m^2 and 12m^2
- category 1 for signs less than 4.7m^2.

For design loadings and other details relating to structure importance, refer to table under section 4.7.14 Design loadings in this document.

4.7.11 Frangible structures

Frangible structures must have an impact performance that meets NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features, or is deemed by the Waka Kotahi Traffic and Safety Manager to meet the standard.

The following requirements shall also apply:

- The maximum weight of the aboveground support structure and sign is 270kg.
- The post mass must be no more than 27kg/m.
- Each leg of the structure must incorporate an approved slip base <100mm above ground level.
- Where an impact is likely to come from multiple directions, a multidirectional slip base is required.
- The underside of a VMS sign enclosure must be at least 3m above ground on a flat site. Where the sign is located on sloping ground, 3m for the downhill end and >2.5m for the uphill end may apply provided that the downhill end is the roadside end and the uphill end is the boundary end.
- The roadside post shall incorporate an approved hinge located immediately below the sign enclosure (refer to the comment below concerning NZTA P24:2020 Specification for Permanent Traffic Signs).
- The power cable feeding the VMS shall allow the slip base to function as intended in an impact.
- When a roadside cabinet is mounted behind a post, the cabinet position must allow a clear space of at least three times the width of any slip base for the slip base to activate in an impact. The width of the slip base is measured in the plane parallel to the road.

See the latest version of ITS standard drawing 000-0000-0-7104-78-RX for a two-line, 200mm-high character sign supported on two posts that may be used for situations within the design criteria.

The following risk-based principles have been applied to the two-post standard design for regional type D VMS (see the latest version of ITS standard drawing 000-0000-0-7104-78-RX):

- The roadside leg is significantly more vulnerable to collision than the boundary leg.
- If the boundary leg is located at the edge of the road reserve, it has a significantly lower risk from collision.
- Because the two legs are approximately 3m apart, it is unlikely both will be hit simultaneously.
- Both legs require slip bases.
- The roadside leg also requires a hinge.
- Due to the limitations of hinge performance, in a collision the enclosure must be supported on the remaining boundary leg post.

In some specific situations, Waka Kotahi may deem the risk of injury to pedestrians and cyclists from breakaway signposts exceeds the risk to the vehicle occupants. In that case, certain requirements of this section may be waived.

4.7.12 Specific engineering design

These are the VMS support structures which are subject to specific engineering design:

- gantry VMS
- cantilever VMS
- single-post centre-mounted VMS not meeting the requirements for use of a standard design (see the latest version of ITS standard drawing 000-0000-0-7104-78-RX)
- dual-post mounted VMS not meeting the requirements for use of a standard design (see the latest version of ITS standard drawing 000-0000-0-7104-78-RX).

Where specific engineering design is required, the design engineer must seek approval of the final VMS support design from the Waka Kotahi regional office. The following information must be submitted for this approval:

- producer statement for design (PS1), in accordance with the requirements of the New Zealand Building Code
- construction drawings
- construction specification
- design calculations.

4.7.13 Foundation design

For the purpose of determining soil foundation capacity, a strength reduction factor (Φ) shall be applied to calculated ideal ultimate soil foundation capacities as follows:

- For signs greater than 12m^2 face panel area, or designated as structure importance level 3, a specific engineering assessment of the soil strength reduction factor (Φ) is required.
- For signs of up to 12m^2 face panel area, that are designated as structure importance category 2: $\Phi = 0.45$.
- For signs of up to 4.7m^2 face panel area, that are designated as structure importance category 1: $\Phi = 0.6$.

4.7.14 Design loadings

Derivation of design wind and earthquake loading is to be based on the following table:

Sign description	Structure importance level (AS/NZS 1170)	Design wind event return period (years)	Design earthquake event return period (years)	Design life (years)
High-value sign Sign face area ≥12m^2 or located over carriageway (includes gantry and cantilevered signs)	3	1000	1000	50
Normal sign Sign face area between 4.7m^2 and 12m^2 and sign not over carriageway	2	500	500	50
Minor sign Low traffic volume rural road, sign face area <4.7m^2 and sign not over carriageway	1	250	100	25

4.7.15 Design wind speed

The design wind speed shall be derived in accordance with AS/NZS 1170.2:2002, with the following specific requirements:

- The design wind speed shall be taken as non-directional.
- The terrain category of a particular site shall be taken as either 2 (exposed rural terrain) or 1 (exposed open terrain). The value of the terrain height multiplier ($M_{Z,\,Cat}$) used must not be less than that given in table 4.1 of AS/NZS 1170 for terrain category 2.

4.7.16 Structure serviceability requirements

Under serviceability limit state wind loadings, the top of the sign shall not deflect more than 0.05h where h is the height from ground level to the top of the face panel.

4.7.17 Low-temperature performance

Except as noted below, structural steel components in signs located in areas where the lowest observed daily mean air temperature (LODMAT) is below 0°C, as detailed in figure 2.6.3.1 of NZS 3404:1997 Steel structures standard, shall satisfy the low-temperature performance requirements detailed in section 2.6 of NZS 3404:1997.

Note: UB and RHS sections that have no welded or bolted connections at their junction with the foundation(s), meet low-temperature requirements.

4.7.18 Durability requirements

All components of the VMS support structure and foundations are to be constructed such that a period of at least 50 years to first maintenance can be achieved in the specific site environment. For steel components this will normally require galvanising.
The designer must consider:

- surface corrosion protection zone (refer AS/NZS 2312 or AS/NZS 4506)
- whether the post needs to be painted and if so, any finished colour requirements.

4.7.19 EJT VMS

EJT VMS/AWS poles shall be ground planted or shear based (bolted to a ground-mounted stub). The selection of ground or shear-based poles shall be based on the principles that the EJT VMS/AWS pole is:

- installed behind a barrier — ground planted
- is without barrier protection — shear base
- is in areas where vehicle speed limit exceeds 60kph or more — shear base.

All EJT VMS/AWS poles shall conform to the latest versions of ITS standard drawings 000-0000-0-7104-20-RX, 000-0000-0-7104-21-RX, 000-0000-0-7104-22-RX and 000-0000-0-7104-23-RX.

The minimum lateral clearance from the support pole, any part of the supporting structure or any part of the EJT VMS/AWS to a point above any part of the carriageway trafficked by motor vehicles must not be less than 500mm. Where the camber of the road is such that large vehicles lean towards the EJT VMS/AWS, the minimum clearance will need to be increased in order that the sign is not struck.

The support pole or any part of the supporting structure or any part of the EJT VMS/AWS must not be located within the swept path of vehicles turning into or out of roadside premises accesses.

When designing sites for type D/EJT signs and ramp signalling AWS, care must be taken to determine the likelihood of vehicles driving and parking on the footpath/verge and to understand the swept path of vehicles entering and leaving domestic and commercial properties where the sign is to be located.

Figure 11. Type D/EJT sign installed over the footpath. This sign was damaged by large vehicles exiting the industrial site on the left — the swept path of heavy vehicles can be seen on the footpath.

All components of the signal and AWS support structures shall be constructed such that a period of at least 50 years to first maintenance can be achieved in the specific site environment.

All EJT VMS/AWS poles, brackets and mounting parts shall be manufactured from mild steel and hot-dip galvanised.

The EJT VMS/AWS shall be mounted on brackets prior to installation onsite.

All EJT VMS/AWS bracket attachments shall be waterproof to prevent moisture getting into the sign once installed on site.

The EJT VMS/AWS pole foundation design shall be based on soil parameters determined from:

- geotechnical investigations conducted as part of the pavement design, and other investigations if visual inspections reveal unsuitable material
- relevant earthworks and/or pavement specifications
- quality assurance testing of fill material
- undrained shear strength of 50kPa where foundations are in natural ground (unless investigations reveal otherwise).

Two foundation options shall be available for each EJT VMS/AWS, namely a pile foundation and a shallow-pad foundation for situations where the pile foundation cannot be installed.

4.7.20 Building consent

As part of implementation of each VMS sign, whether or not a standard solution is adopted, application shall be made to the territorial local authority for exemption from requiring building consent.

If the territorial local authority advises that building consent is required, this shall be obtained prior to construction commencing.

4.7.21 Site set-out

Before construction commences the contractor shall satisfy the Waka Kotahi representative that the foundation construction methodology will achieve optimal alignment of the LED viewing angle for approaching motorists.

Horizontal alignment of the VMS shall be achieved by correct alignment of the gantry span for gantry-mounted motorway VMS, or support posts for regional VMS.

4.7.22 Motorway VMS orientation

The VMS shall be orientated such that it complies with the relevant beam-width class specified in EN 12966:2014+A1:2018 Road vertical signs. Variable message traffic signs.

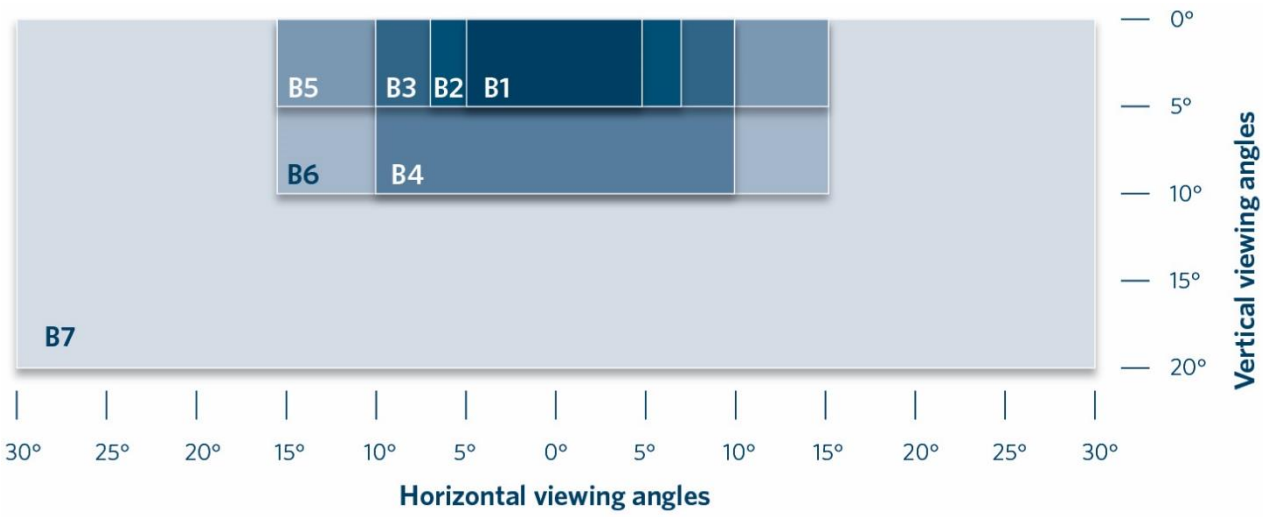


Figure 12. Relation between classes.

The horizontal alignments for straight and curved approaches are illustrated below.

For curved approaches, the VMS must be aligned to ensure:

- at the maximum reading distance, the inside edge of the curve is within the cone of visibility
- approaching the VMS, the outside edge of the curve remains within the cone of visibility for as long as possible.

For further guidance, refer to EN 12966:2014+A1:2018 Road vertical signs. Variable message traffic signs section N.4.3.

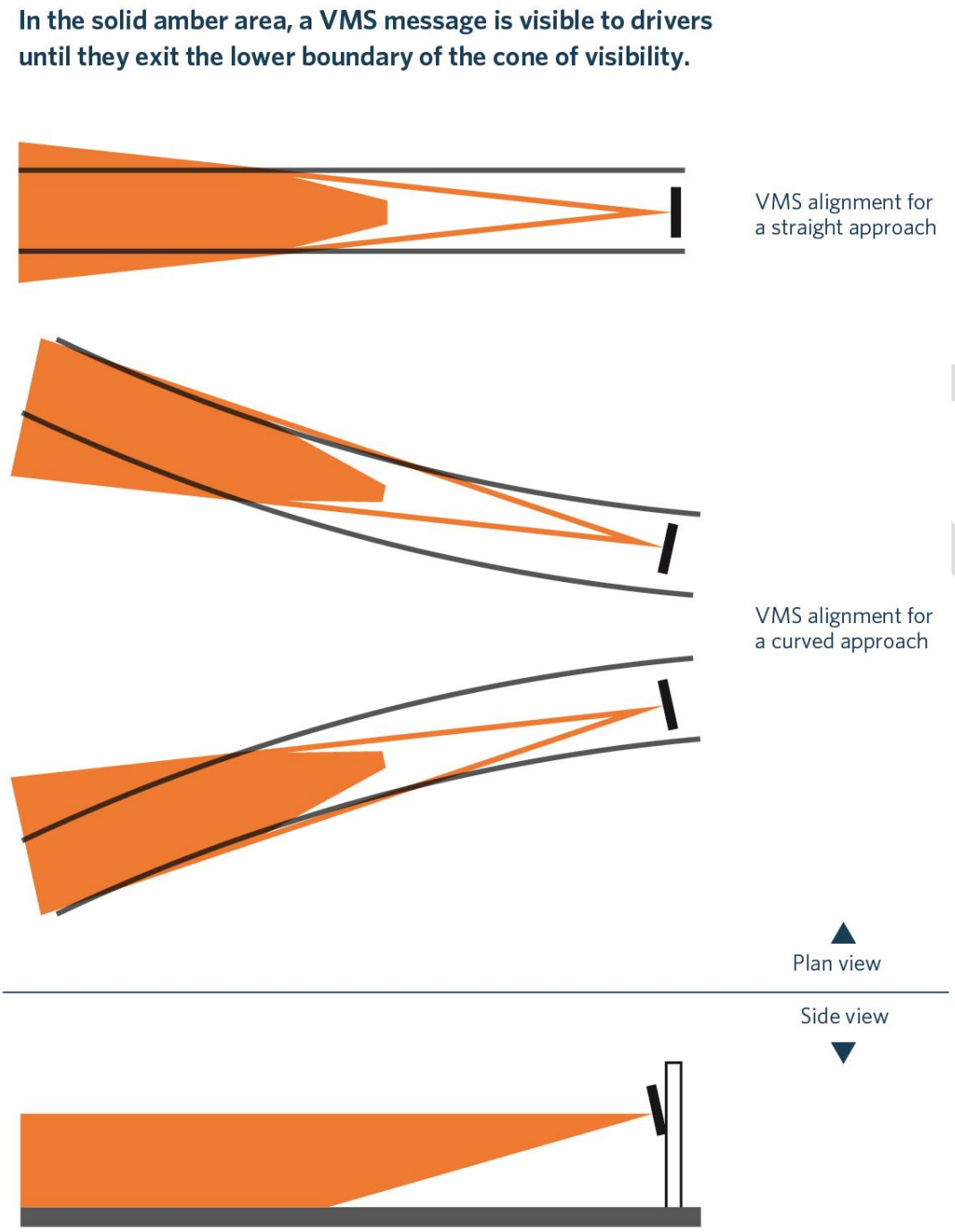


Figure 13. Example of optimising sight lines for a motorway VMS on an overhead gantry.

4.7.23 Regional VMS

Regional VMS are normally mounted on the side of the roadway on the left-hand side of approaching traffic where there is a single approaching lane. For a straight approach, the offside edge of the cone of visibility should be aligned down the road reserve parallel with the road.

For VMS mounted some distance beyond a left or right-hand curve, alignment should maximise the time that travellers remain within the cone of visibility, as illustrated below.

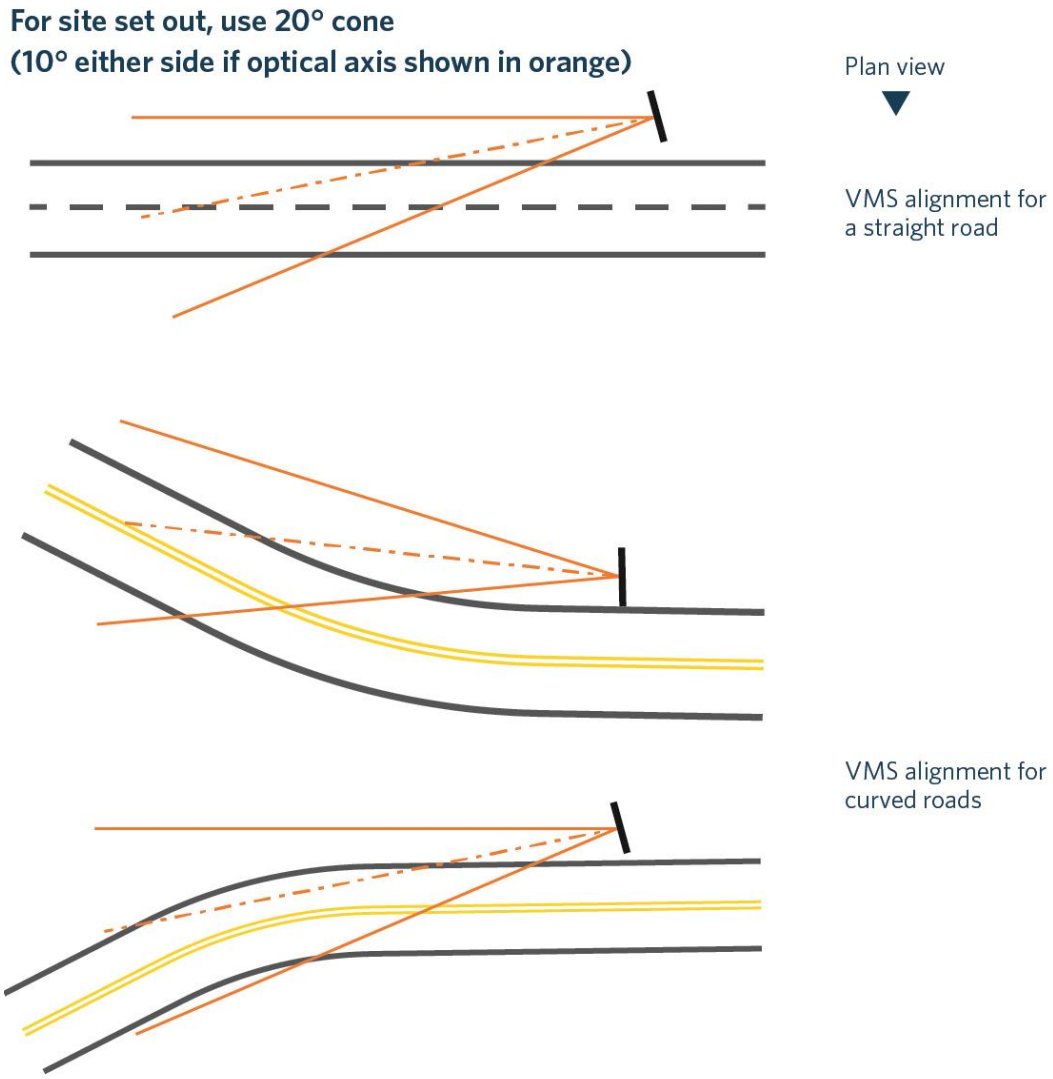


Figure 14. Example of optimising sight lines for a regional VMS on a roadside support structure.

4.7.24 EJT VMS/AWS

The EJT VMS/AWS pole foundation stubs shall be supplied to match the EJT VMS/AWS support poles.

4.7.25 Unforeseen foundation conditions for regional VMS

The contractor is to be familiar with the foundation soil properties assumed in the design of each sign, as detailed in the contract documents and in this design standard.

If the foundation soil properties encountered during construction differ from those assumed in design, the contractor is to immediately cease work at the site and bring this to the attention of the Waka Kotahi representative, who will assess the unforeseen conditions and advise how construction is to proceed.

In practice, for scala penetrometer testing (where this is appropriate for the soil type) the foundation soil is considered adequate if at least three blows are required to advance 100mm depth, to a minimum depth of 1m below ground level.

In addition to the minimum bearing strength requirement, the foundation soil must fulfil the following requirements:

- groundwater table is below the proposed foundation depth (unless specifically allowed)
- topsoil, very soft or very loose surface sediments shall not be included in the embedment depth given above. In no case should this be greater than a depth of 200mm
- no peat is present
- no soft clay is present
- there is no loose fill present.

4.8 Lane and carriageway signals

4.8.1 Gantry type

LCS/VMSL gantry structures shall be:

- truss gantries with LCS separately bolted onto the gantry truss
- either a portal frame truss spanning one carriageway or the entire highway, or a cantilever truss spanning one carriageway.

Each LCS/VMSL shall be located over the centre of each lane.

4.8.2 Gantry design

See section 4.2 Support structures in this document.

Shop drawings for both the LCS support frame and the gantry structure shall be submitted to the Waka Kotahi Engineer for comment prior to fabrication of the gantry structure.

4.8.3 LCS/VMSL backing boards

The contractor shall supply to the Waka Kotahi Engineer detailed drawings and specifications for the supply and installation of the LCS/VMSL backing boards.

4.9 Ramp signalling system

4.9.1 Support structure types

RSS traffic signal structures shall, depending on the type and location, be one of the following (poles or gantry).

4.9.1.1 Poles

Traffic signal poles shall be used in majority cases to mount the ramp signal traffic signals. There are a wide variety of poles available to suit a number of installation requirements.

Poles may be ground planted when used behind barriers, shear based (frangible) for when no barrier is provided, or hinge based for use behind barriers and on an over-dimension route.

4.9.1.2 Gantry

Depending on the design criteria, a ramp signal installation may require gantry-mounted LED traffic signal heads. These will normally be used when a bypass or priority lane has been installed on the on-ramp or when there are more than two signalised lanes.

4.9.2 Support structure design

Ramp signal pole and gantry design shall conform to the latest versions of ITS standard drawings range 000-0000-0-7104-10-RX to 000-0000-0-7104-16RX, 000-0000-0-7104-19RX and from 000-0000-0-7104-24-RX to 000-0000-0-7104-33-RX.

4.9.3 Ramp signal pole foundations

The ramp signal pole foundation stubs shall be supplied to match the ramp signal support poles. Each support structure shall follow the requirements of the relevant ITS standard drawings.

The cable ducts to the roadside control cabinet shall be a 100mm NB extra high-impact PVC-U duct with long-radius bends into the ramp signal pole or gantry foundation stub and into the roadside control cabinet. The duct shall be supplied and installed in accordance with the latest version of ITS design standard: Ducts.

The top face of frangible pole stubs shall provide clearance for maintenance of the fixing bolts and shall not be more than 100mm above finished ground level.

4.10 Installation

To be defined.

5 DESIGN FOR SAFETY

This section defines the requirements to ensure the intelligent transport system can be operated and serviced safely.

5.1 Health and safety

All ITS equipment must be designed to ensure installation and maintenance in accordance with the Health and Safety at Work Act 2015.

HSiD is defined as 'the integration of hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life of the product being designed'.

HSiD is a standard that integrates hazard identification and risk assessment methods early in the design process. The standard considers how to eliminate, isolate or minimise the risks of death, injury and ill health to those who will construct, operate, maintain, decommission or demolish an asset.

HSiD begins in the conceptual and planning phases of a project. The emphasis is on making the right choices about the design as early as possible to enhance the safety of the project. These choices may include appropriate methods of construction, ongoing maintenance provisions or materials used.

Most construction safety risk mitigation is aimed at isolating, informing or controlling the hazard. The opportunity to consider the lifecycle of the project and involve decision-makers in the early design stages to eliminate a hazard is invaluable. The earlier you can begin this process in the design stages, the easier it is to make changes that benefit everyone. The design stage offers the greatest opportunity to incorporate improvements that can produce time and cost savings over the life of the asset.

Typically, most construction risks are mitigated by isolating, informing and controlling the hazard. By applying an HSiD process in the early project development phase, designers have the opportunity to eliminate safety risks altogether.

The hierarchy of hazard control when considering HSiD should be consistent with the Health and Safety in Design Minimum Standard (ZH/MS/01).

All ITS installations require road safety audit processes to be applied using the Waka Kotahi Road safety audit procedures for projects guidelines.

5.2 Safety outcomes

5.2.1 Safety barriers

The designer shall refer to Specifications and notes for road safety barrier systems on state highways (NZTA M23).

- A safety barrier shall be installed where a non-frangible hazard is located where it could reasonably be hit by an errant vehicle.

- Design of new barriers shall be completed in accordance with the latest relevant standards and guidelines adopted by Waka Kotahi. These include, but are not limited to:
  - Bridge manual (SP/M/022)
  - AS/NZS 3845.1.2015 Road safety barrier systems
  - NZTA M23
  - AASHTO Manual for Assessing Safety Hardware (MASH)
  - State highway geometric design manual (SHGDM).

5.2.1.1 Barrier implementation

The decision to implement barriers shall be based on the following risk management process:

- determining whether a barrier creates a greater hazard than the hazard it is protecting
- determining the lateral distance between the barrier and the hazard
- selection of design vehicle
- calculation of speed at the hazard
- selection of test level
- calculation of the length of need
- selection of terminals.

5.2.1.2 Barrier design philosophy

The following philosophy shall be adopted in the design of the barriers:

- Barriers are to conform to a minimum performance level of TL3, except where the distance between the barrier and the hazard is less than 1m, in which case the barriers are to conform to TL4.
- The selection of test levels greater than the minimum required to satisfy the deflection criteria shall be determined using the following:
  - SP/M/022
  - NZTA M23 is appropriate for determining barriers for bridges, roadsides and medians
  - Barrier requirements in the SHGDM (considered appropriate where single-sided barriers are proposed)
  - Notwithstanding the above, test level 5 barriers shall be considered where vehicles with higher centres of gravity need to be retained.
- End terminals shall meet test level 3 requirements and considered as part of the length of need only in accordance with the manufacturer's specifications.
- Where practicable, a gap of 0.5m shall be provided between the barrier and retaining wall to mitigate against load transfer to the retaining wall during impact.
- Where there is a conflict in the requirements of the test level for barriers, such conflict shall be discussed with the relevant Waka Kotahi representative and an appropriate course of action agreed upon.
- The barrier system shall be installed in accordance with AS/NZS 3845 Road Safety Barrier Systems, SHGDM: State Highway Geometric Design Manual, TNZ M/23 Notes: Notes on the Specification for Road Safety Barrier Systems, and the manufacturer's specifications.

5.2.2 Maintenance access

A safe (from slips and trips) access path shall be provided to all ITS equipment and all supporting structure sites connecting to a suitable hard standing area to give access for parking a maintenance vehicle.

5.2.3 Poles

Installations shall be sited away from any other structures that might allow potential vandals easier access to them.

The supporting pole shall not be fitted with any rungs, ladders, or any other fixture that might allow the general public to climb the structure.

Hinged folding poles shall be aligned and located to swing down parallel to and clear of any carriageway and clear of the site roadside control cabinet or any other obstructions.

5.2.4 Wind-down poles

A power failure during raising or lowering shall not result in the camera falling back down the pole.

5.2.5 Traffic management

TTM for the site activities shall conform to the Code of practice for temporary traffic management (CoPTTM).

5.3 Site assessment

To be defined.

5.4 Site audit

To be defined.

5.5 System-specific safety requirements

To be defined.

6 DESIGN FOR MAINTAINABILITY

This section defines the requirements to ensure the intelligent transport system can be maintained.

6.1 Maintenance outcomes

6.1.1 Construction verification

At the start of the works, it is the contractor's responsibility to engage with the maintenance contractor and agree how to handover after construction is complete.

At completion of the works, the contractor shall supply a producer statement for the entire construction.

A Waka Kotahi representative shall verify the adequacy and accuracy of the civil works by undertaking a civil site acceptance test (civil SAT).

6.1.2 Wind-down poles for CCTV

There should be a means of manually raising/lowering the camera in the event of a power failure.

If a wind-down pole is provided, space shall be made available to house the wander lead and/or the extension cable in an adjacent secure ITS cabinet if it is required to be left on site.

The design of the pole shall permit the CCTV camera to be capable of being powered and operated whilst in the lowered position.

The risk of cables or connectors becoming caught in the winding mechanism shall be demonstrated to have been avoided.

The pulleys shall be maintenance free.

6.1.3 Maintenance access

6.1.3.1 Site considerations

The decision whether to provide a maintenance access point is determined by the nature of the site, the type of asset to be maintained and the physical attribute of the road at that location.

It may not be practical or possible to provide maintenance parking in urban areas, whilst quiet rural highways may require a different form of access to that provided on a busy motorway. Therefore, one size does not fit all and the facility provided needs to be safe and appropriate for the location.

For CCTV sites with fixed CCTV poles and for regional VMS sites (VMS is installed on pole), the hardstanding area shall be designed to accommodate a maintenance vehicle, or a scissor lift and its towing vehicle, or a hydraulic crane with a railed platform (commonly called a cherry picker) that will be used to gain access to the face of the VMS or gain access to all of the equipment on the CCTV pole. The paved area shall be sufficient in size and strength to accommodate any stabiliser arms from the scissor lift or cherry picker.

For LCS gantries, VMS gantries, mid-hinged folding CCTV poles, lowering CCTV poles and overhead gantry-mounted CCTV cameras (or sites with any mix of these asset types), the hardstanding areas shall be designed to accommodate a maintenance vehicle, typically a ute.

For mid-hinged CCTV sites, the access pad shall be positioned with consideration given to the swept path of the pole so that the maintenance vehicle does not impede the operation of the pole. The additional area required to lower the pole should be solid, free of vegetation and free of standing water or mud. There shall be sufficient firm, level ground beneath the arc of the tail section of mid-hinged folding pole to allow staff to carry out maintenance activities safely. There shall be a firm level area by a mid-hinged folding pole that allows staff to safely conduct maintenance activities on the CCTV camera in its lowered position. The area around the base of the CCTV pole where maintenance activities take place and the area around the ladder access to gantries shall be suitable for their intended purpose, level and free from trips, slips, overgrowing vegetation and sudden drop-offs.

Access to and from assets, gantries and roadside cabinets from the parking area shall be from behind the safety barrier and shall be solid and free of vegetation and standing water or mud.

6.1.3.2 VMS

Where access is required to the face of motorway and expressway VMS, it will need to be done from the carriageway under TTM. Routine maintenance can be conducted from the back of the sign via the gantry access ladder.

6.1.3.3 LCS

Where access is required to the face of motorway and expressway LCS, it will need to be done from the carriageway under TTM. Routine maintenance can be conducted from the back of the sign via the gantry access ladder.

6.1.3.4 RMS

A consultation should be undertaken with the relevant maintenance organisation regarding maintenance access requirements.

6.1.3.5 Roadside cabinets

The roadside cabinet shall be positioned as close as practically possible to associated LCS/VMSL gantry.

6.1.3.6 Pavement construction

The surface of the maintenance hardstanding and access shall not contain any loose material or mud that can be tracked onto the carriageway.

The pavement construction shall be sufficiently robust to accommodate the vehicle type expected to use it with no deformation, cracking or breaking up.

6.1.3.7 Parking area

Where the maintenance access is behind a barrier, such as on a motorway or expressway, the maintenance access shall be designed in such a way as to permit the vehicle to be parked behind the barrier and outside of its deflection zone (when a person gets out of the car, the distance from him to the barrier shall be more than 1m — as required by CoPTTM).

Figure 15. Maintenance access under construction with asphalt surface and barrier protection.

Figure 16. Safe ladder access to a VMS gantry.

6.1.3.8 Access and egress

The form the access takes will depend on whether there is a road shoulder or not. For access, the maintenance vehicle must be able to safely pull off into the maintenance bay. For egress, the maintenance vehicle must be able to safely accelerate back into the live traffic stream. On a low-volume (750 vehicles per hour or less) rural highway, the maintenance access could be perpendicular to the carriageway, but on a motorway or expressway, the hard shoulder will be required to permit the vehicle to decelerate, stop and reverse into the maintenance bay taper. The hard shoulder is then used to accelerate along before merging and rejoining the live main carriageway (presuming the hard shoulder has sufficient width to do so).

There shall be no kerb or upstand at the edge of the carriageway which will permit an out-of-control vehicle to 'launch' as it is struck, as the vehicle may hit the barrier in such a way as to be outside the design parameters of the barrier.

The merge taper and lateral access will be dependent on the barrier system used and are likely to differ. The design must allow sufficient space for a maintenance vehicle to come off, or accelerate back onto the carriageway at a safe speed, with or without a hard shoulder. Typical maintenance access arrangements are shown below.

Consultation should be undertaken with the relevant maintenance organisation regarding maintenance access requirements.

Figure 17. CCTV, communications cabinet and ramp signals cabinet on a constrained site. Note the bump stop for the reversing maintenance vehicle.

Figure 18. New maintenance access for CCTV site that doubles as a grass-cutting maintenance access site.

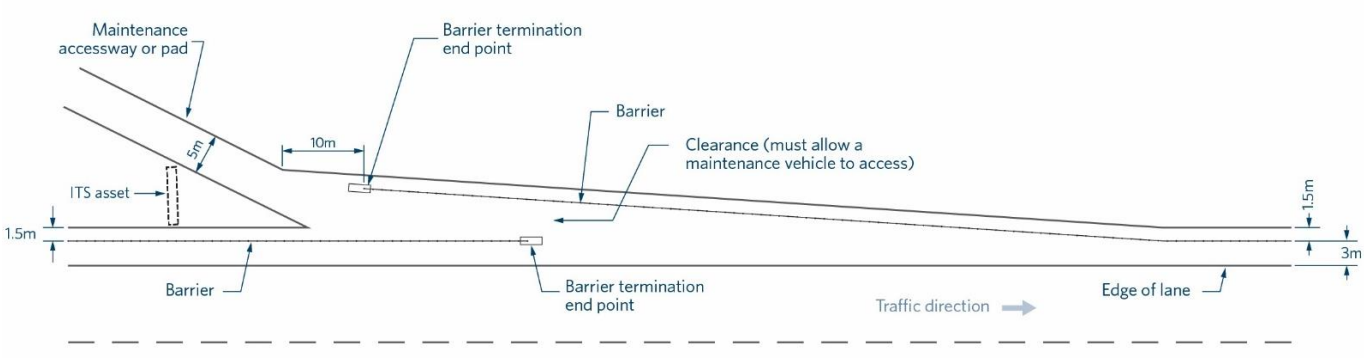


Figure 19. Example layout and key features for access to a maintenance bay.

7 DESIGN FOR SECURITY

This section defines the requirements to ensure the intelligent transport system can be secured and maintain integrity.

7.1 Security outcomes

7.1.1 Poles for CCTV

A padlock keyed to the local AT standard will be used to secure the pole from unauthorised lowering.

8 APPENDIX A – <TITLE>

9 APPENDIX B – <TITLE>

10 REFERENCES

This section lists all external and Waka Kotahi references included in this document.

10.1 Industry standards

10.1.1 Support structure performance

Standard number / name	Source	Licence type and conditions
AS 1111 ISO metric hexagon bolts and screws		
AS/NZS 1163:2016 Cold-formed structural steel hollow sections		
AS/NZS 1170 Structural design actions		
AS/NZS 1252 High-strength steel bolts with associated nuts and washers for structural engineering		
AS/NZS 1554 Structural steel welding		
AS/NZS 1664 Aluminium structures		
AS/NZS 1866:1997 Aluminium and aluminium alloys – Extruded rod, bar, solid and hollow shapes		
AS/NZS 2312 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings		
NZS 3101.1&2:2006 Concrete structures standard		
NZS 3104:2003 Specification for concrete production		
NZS 3124:1987 Specification for concrete construction for minor works		
NZS 3404 Parts 1 and 2:1997 Steel structures standard		
AS/NZS 3678:2016 Structural steel – Hot-rolled plates, floorplates and slabs		
AS/NZS 4203 General structural design and design loadings for buildings		
AS/NZS 4506 Metal finishing – Thermoset powder coatings		
AS/NZS 4671:2019 Steel for the reinforcement of concrete		
AS/NZS 61386 Conduit systems for cable management		
Health and Safety at Work Act 2015	NZ Legislation website	Public

10.1.2 Protective coatings

Standard number / name	Source	Licence type and conditions
AS 1650 Hot-dipped galvanised coatings on ferrous articles		
AS/NZS 4680:2006 Hot-dip galvanised (zinc) coatings on fabricated ferrous articles		
AS/NZS 4791:2006 Hot-dip galvanised (zinc) coatings on ferrous open sections, applied by an in-line process		
AS/NZS 4792:2006 Hot-dip galvanised (zinc) coatings on ferrous hollow sections, applied by a continuous or specialised process.		

10.1.3 Miscellaneous

Standard number / name	Source	Licence type and conditions
AS 1204 Add name when confirmed by review author		
EN 12966:2014+A1:2018 Road vertical signs. Variable message traffic signs		
T-CES 306		
T-CES 101		
AS/NZS 3845.1.2015 Road safety barrier systems		
AASHTO Manual for Assessing Safety Hardware (MASH)		
NCHRP Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features		

10.2 Waka Kotahi standards, specifications and resources

10.2.1 Standards and specifications

See the Waka Kotahi website for the latest versions of the ITS design standards, delivery specifications and core requirements listed below.

Document name
ITS design standard: Ducts
ITS design standard: CCTV
ITS delivery specification: CCTV

Document name
ITS delivery specification: VMS – fixed

10.2.2 Resources

Document name / code	Waka Kotahi website link
Code of practice for temporary traffic management (CoPTTM)	https://www.nzta.govt.nz/resources/code-temp-traffic-management
Bridge manual (SP/M/022)	https://www.nzta.govt.nz/resources/bridge-manual/
Specifications and notes for road safety barrier systems on state highways (NZTA M23)	https://www.nzta.govt.nz/resources/road-safety-barrier-systems
Specification for Permanent Traffic Signs (NZTA P24:2020)	https://www.nzta.govt.nz/assets/resources/traffic-signs-perf-based-specs/docs/traffic-signs-perf-based-specs.pdf
Health and Safety in Design Minimum Standard (ZH/MS/01)	https://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Zero-harm/Safety-in-design/ZHMS-V02-Minimum-Standard-Safety-in-Design-for-Road-Projects.pdf
State highway geometric design manual (SHGDM)	https://www.nzta.govt.nz/resources/state-highway-geometric-design-manual/shgdm/
Road safety audit procedures for projects guidelines 2013	https://www.nzta.govt.nz/resources/road-safety-audit-procedures/

10.3 Drawings

See the Waka Kotahi website for the latest versions of the ITS standard drawings listed below.

Drawing number / name
000-0000-0-7104-03-RX
000-0000-0-7104-04-RX
000-0000-0-7104-45-RX
000-0000-0-7104-46-RX
000-0000-0-7104-47-RX
000-0000-0-7104-52-RX
000-0000-0-7104-53-RX
000-0000-0-7104-54-RX
000-0000-0-7104-55-RX
000-0000-0-7104-56-RX
000-0000-0-7104-57-RX

Drawing number / name
000-0000-0-7104-58-RX
000-0000-0-7104-59-RX
000-0000-0-7104-60-RX
000-0000-0-7104-61-RX
000-0000-0-7104-62-RX
000-0000-0-7104-63-RX
000-0000-0-7104-67-RX
000-0000-0-7104-68-RX
000-0000-0-7104-69-RX
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000-0000-0-7104-83-RX
000-0000-0-7104-84-RX
000-0000-0-7104-85-RX

11 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class
4.7.7	VMS sign mounting height	Variable message signs – fixed design standard	001 Signs
4.7.22	Motorway VMS orientation	Variable message signs – fixed design standard	001 Signs
4.7.23	Regional VMS	Variable message signs – fixed design standard	001 Signs
4.8.3	LCS/VMSL backing boards	Lane and carriageway signals delivery specification	003 Signals