



Ministry of
Transportation
and Infrastructure

ELECTRICAL AND TRAFFIC ENGINEERING MANUAL

Section 500

Electrical and Sign Support Structures

Electrical and ITS Engineering

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Electronic versions of this manual and appendices available at:

http://www.th.gov.bc.ca/publications/eng_publications/electrical/electrical_and_traffic_eng/Electrical_Signing_Design_Manual/tableofcontents.htm

501 INTRODUCTION

501.1 ABOUT SECTION 500

- .1 Section 500 provides guidelines for the design of electrical and signing infrastructure used on ministry of Transportation and Infrastructure roadways within the Province of British Columbia. The scope of this section includes all aspects related to the design of signal, lighting, and signing installations including support structures, underground equipment, electrical design, and clear zone requirements.
- .2 Technical information specific to lighting design, such as lighting levels, luminaires, types of lighting systems and applications are covered in Section 300.
- .3 Technical information specific to signal design such as signal head mounting, pushbuttons, audible signals, fire indication lights, telephone demarcation panels, traffic controllers, advance warning signs and detector loops are covered under Section 400.

501.2 BEFORE YOUR BEGIN

- .1 Designers shall use the latest edition of the ministry of Transportation Standard Specifications for Highway Construction, Section 635 - Electrical and Signing as a reference.
- .2 Designers shall reference the applicable manuals and documents noted in Chapter 104.

502 UNDERGROUND DESIGN

502.1 CONCRETE BASES

- .1 Concrete bases are used to support poles, controllers and sign structures.
- .2 Refer to the Concrete Base Index in Section 635, drawing number SP635 – 1.1.1 of the ministry Standard Specifications for Highway Construction for a listing of all standard ministry bases and the structures.
- .3 When specifying Type D, E, F, S, L, M or H concrete bases, designers shall select the most cost-effective base as determined by the cross-section of the site. General guidelines as noted on the Luminaire Pole Base Installation & Backfill Requirements Drawings in Section 635 drawings SP635 – 1.4.4 and 1.4.5 of the ministry Standard Specifications for Highway Construction are as follows:
 - .1 Types D2, D3, E2, E3, F2, F3, S2, S3, L2, L3, M2 and H2 concrete bases are designed for installation in flat ground that is level for a minimum of 2 times the base depth. This shall apply all around the base.
 - .2 Types D1, E1, F1, S1, L1, M1 and H1 are spread footing bases and are designed for fill slopes where the ground surrounding the base is not level. Where bases listed under Paragraph 502.1.3.1 above will not work due to site conditions, use these spread footing bases.
- .4 Designers shall ensure that all concrete bases are constructible in the locations selected and that no conflicts exist with underground utilities.
- .5 Where possible offset bases to avoid the cutting and/or shoring of the existing asphalt.
- .6 Minimum soil bearing pressures for which the concrete bases are designed are indicated on the Concrete Base Drawings in Section 635 of the ministry *Standard Specifications for Highway Construction*. If minimum soil bearing pressures are less than noted an alternate custom base design may be required. This will need to be confirmed by a geotechnical engineer.
- .7 Cantilever and sign bridge sign structure concrete bases shall be designed to suit the soil conditions and the ultimate pole loading. Refer to Clause 505.3 for more information on cantilever and sign bridge structures.
- .8 Highmast structure concrete bases shall be designed to suit pole loading and soil conditions. Refer to Clause 306.2 for more information on highmast lighting.
- .9 Where back slopes around bases are 1.5:1 or greater, designers should consider specifying concrete filled sand bags to reinforce the slope and to prevent soil erosion.

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502.2 JUNCTION BOXES AND VAULTS

- .1 Junction boxes are typically used to make conduit and wiring connections at each pole or each split in the conduit system. Junction boxes are normally not spaced more than 100 meters apart. Wire theft has become an issue in some regions of the province, particularly in Region 1. In order to reduce access to wiring the use of junction boxes for street lighting and island flashers in Region 1 must be approved by the ministry Manager, Electrical Services prior to design.
- .2 Where junction boxes are not used, an additional conduit will be required in the concrete base to allow direct entry and exit of the conduits and conductors. See the *Standard Specifications for Highway Construction* drawing SP635 – 1.1.3a *Type CM Modified Type C concrete Base* which has dual conduits and eliminates the requirement for a junction box.
- .3 Junction vaults for ITS applications are unique and covered under Clause 600.2.
- .4 Position junction boxes so they are clear of vehicle wheel paths and pedestrian walking areas. Boxes shall also be located to allow for easy access by maintenance personnel. When locating boxes and conduit at a signalized intersection the designer shall take into account future widening and if possible locate boxes and conduit so they do not have to be relocated in the future.
- .5 Junction boxes shall be positioned on the downstream side of poles.
- .6 Where practical, the number of junction boxes shall be kept to a minimum. For instance, avoid placing a junction box adjacent to a concrete base when the base is less than 10 m from another junction box. Avoid locating junction boxes in sidewalks where possible.
- .7 Refer to the ministry *The ministry Standard Specifications for Highway Construction* drawings SP635 – 1.2.1 to 1.3.4 for junction box installation details and the ministry *Electrical and Signing Materials Standards* drawings MS200.1 to MS203.4 for junction box materials specifications. Standard types of junction boxes and vault equipment are as follows:
 - .1 Large round plastic junction boxes (Types 10 to 13)
 - .2 Rectangular plastic junction boxes (Types 6 to 9) – No longer used on new installations.
 - .3 Small round plastic junction boxes (Type 14)
 - .4 Concrete junction box
 - .5 Small concrete vault
 - .6 Telecommunications vault (Refer to Section 600 ITS for specific information)
- .8 Types 10 to 13 large round plastic junction boxes are described as follows:

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- .1 Type 10 is comprised of two plastic sections, a steel lid and a plastic drain plate in accordance with Type 10 Junction Box Installation Drawings in Section 635 of the ministry *Standard Specifications for Highway Construction* drawing SP635-1.2.7. This box is used in many applications except where listed below under Paragraphs 502.2.6.2 to 502.2.6.4.
- .2 Type 11 is comprised of three plastic sections, a steel lid, and a plastic drain plate in accordance with Type 11 Junction Box Installation Drawing in Section 635 of the ministry *Standard Specifications for Highway Construction* drawing SP635-1.2.8. This box is used in all curb areas. The height of the extra box section compensates for the curb height and allows conduits to be buried to their required depth. This configuration of junction box allows for elevation adjustment at the time of installation.
- .3 Type 12 is comprised of three plastic sections, a steel lid and a plastic drain plate in accordance with the Type 12 Junction Box Installation Drawing in Section 635 of the ministry *Standard Specifications for Highway Construction* drawing SP635-1.2.9. This box is used in all medians or islands with median or island curbs. Refer to Paragraph 502.2.9 for an explanation of curb types. The main advantage of this box over a Type 11 is that the main box can be installed in advance of paving and curb installation. The top section is then cut to suit finished grade.
- .4 Type 13 is comprised of one plastic section and steel lid in accordance with the Type 13 Junction Box Installation Drawing in Section 635 of the ministry *Standard Specifications for Highway Construction* drawing SP635-1.2.10. This box is generally used at the ends of islands or medians with island and median curb where the conduit is run on top of the pavement.
- .9 Small round plastic junction boxes are used for short duration traffic counter stations and in narrow traffic islands. Type 14 small round plastic junction boxes are described as follows:
 - .1 Type 14 is comprised of two plastic sections, a steel lid and a plastic drain plate in accordance with the Type 14 Junction Box Installation Drawing in Section 635 of the ministry *Standard Specifications for Highway Construction* drawing SP635-1.2.14. This box is can be used in applications where loop detector conduits buried at a shallow depth are present. Due to a lack of height, the 600 mm bury required for electrical conduits cannot be maintained when installed in curb areas.
- .10 Rectangular plastic junction boxes are no longer for new installations. ministry Electrical Maintenance Contractors maintains stock to replace existing boxes that are damaged.

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- .11 The different types of curb, and curb and gutter are described below:
 - .1 Curb and gutter is may be used for raised islands and medians. The curb and gutter is generally extruded or hand formed prior to paving.
 - .2 Island or median curbs are generally used for small medians and islands where the curb is extruded onto the final lift of pavement.
- .12 The maximum number of conduits entering a Type 13, or 14 junction box should not exceed three: two 50mm RPVC and one 25mm RPVC for the detector loop(s).
- .13 The maximum number of conduits entering a large round plastic junction box shall not exceed ten. Where more than 10 conduits enter a box see Sub-clauses 502.2.14 and 502.2.2.15 below.
- .14 Concrete junction boxes can be used in areas where ten to twenty conduits enter a box. They can be located at corners of signalized intersections and at traffic controllers. Concrete junction boxes are as detailed on the Concrete Junction Box Drawings in Section 635 of the ministry *Standard Specifications for Highway Construction* drawings SP635-1.3.1 and SP635-1.3.2.
- .15 Small concrete vaults can be used where more than twenty conduits enter a box. Small concrete vaults are detailed in Section 635 of the ministry *Standard Specifications for Highway Construction* drawing SP635-1.3.3. Designers shall pay particular attention to drainage when using this small concrete vault in a design. This may involve a tie into a ditch or storm drain.
- .16 Concrete communication vaults may be required for ITS applications. These are defined in Section 600.
- .17 Where conduit depths exceed 600 mm (e.g., at railway crossings or where conduits are drilled deeper to avoid utilities), a single section large round plastic junction box shall be used with the conduit entering into the bottom of the box with a 90° bend. 150 mm of 19 mm drain rock shall be placed under the box for drainage. Conduit shall be terminated with couplings 200 mm above drain rock.
- .18 All junction boxes shall be specified with steel lids. Plastic junction box lids may be considered in areas behind barriers or sidewalks.
- .19 Where possible avoid using junction boxes in bridge decks by loop feeding the conduits into the pole base. Where boxes are required they shall be cast into the bridge parapet. Junction boxes shall be RPVC type, or approved alternate, and shall be sized to suit the number of conduits. Where boxes are required in sidewalks they shall be located outside of the pedestrian path. All boxes in sidewalks shall have load rated lids.

UNDERGROUND DESIGN

502.3 UNDERGROUND CONDUIT

- .1 Buried conduits are generally 50mm RPVC, except in the following applications:
 - .1 In areas where conduit fill exceeds the capacity of a 50mm conduit, 75mm conduit may be used.
 - .2 Communications conduits shall be a minimum of 50mm. Designers shall confirm the size, type and number of communications conduits required with the ministry Electrical and ITS Engineering.
 - .3 Detector loop lead conduits shall be 25mm RPVC as noted on Loop Conduit Installation Drawings in Section 635 of the ministry *Standard Specifications for Highway Construction*. One loop conduit is required for each lane of vehicle detection.
 - .4 Conduit from a post mounted flasher to the nearest junction box (in a raised island) shall be 25mm RPVC as noted on Post Mounted Flasher Concrete Base Installation Drawing in Section 635 of the ministry *Standard Specifications for Highway Construction*.
- .2 Three 50mm RPVC conduits shall be installed across each leg of a signalized intersection. Where there is a possibility of future signalization or lighting in areas of new road construction or repaving, pre-ducting for future signals or lighting should be considered. Designers shall always consider additional conduits to accommodate future infrastructure. When locating boxes and conduit at a signalized intersection the designer shall take into account future widening and, if possible, locate boxes and conduit so they don't have to be relocated in the future. 75mm RPVC conduit should also be considered when signal cable is being used.
- .3 Where open trenching:
 - .1 Does not present a problem, such as in areas where the intersection will be resurfaced, all legs shall be crossed.
 - .2 Does present a problem, such as when the pavement is relatively new, the highway shall be crossed only once, where possible. Where site conditions allow, conduits shall be installed using trenchless technology to avoid cutting the paved surface. The designer shall define "Trenchless Technology" as opposed to defining a specific method (i.e., drilling, auguring, jacking, etc).
- .4 All conduits shall run as straight as possible from the junction box to junction box. Conduit runs in roadways shall be kept as short as possible.
- .5 Conduit for ITS applications is unique and covered under Clause 600.2. The information in this Clause shall apply except where specifically noted in Clause 600.2.

UNDERGROUND DESIGN

- .6 Designers shall seek approval from the appropriate railway authority to install conduit under railway tracks. This generally requires a permit be obtained from the railway authority. In most cases, railway authorities require the 50mm RPVC conduit installed in a 75mm casing pipe and pushed or drilled under the tracks at a depth of 1200 mm. For further direction on railway crossing permits contact the ministry Rail & Navigable Waters Coordinator.
- .7 The ministry requires that conduit generally be cast into most new bridge structures in areas anticipated to have future electrical infrastructure. The conduit shall be either installed in the parapet or the deck. Each bridge expansion joint shall have conduit expansion fittings. Where bridge settlement is a concern, expansion/deflection fittings shall be specified. Designers shall confirm the need for conduit with ministry Electrical and ITS Engineering and confirm conduit size and routing with the bridge design engineer.
- .8 Designers shall exercise caution when locating conduits or any other electrical equipment near gas station pumps, vents and storage tanks. Distance from conduits and junction boxes to pumps, vents and storage tanks shall meet Canadian Electrical Code requirements.
- .9 Conduits may be surface mounted as follows:
 - .1 Rigid Metal Conduit (RMC) should be considered for most surface mounting applications where the conduit diameter does not exceed 50mm.
 - .2 Flexible Metallic Conduit (FMC) should be considered for surface mount applications where minor bends are required.
 - .3 RPVC is the most economical and should be considered for surface mount applications where the conduit is not subject to physical damage, prolonged U.V. exposure, or fire, since RPVC may produce toxic fumes.
 - .4 FRE Conduit should be considered as an alternative to RMC and FMC for 50mm and larger diameters.

503 CLEAR ZONE

503.1 GENERAL

- .1 The clear zone is defined as an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway. The width of the clear zone is dependent upon the design traffic volume, design traffic speed, and the roadside geometry.
- .2 The following equipment may be located within the clear zone:
 - .1 Luminaire and sign poles in raised islands and medians
 - .2 Breakaway sign structures
 - .3 Perforated square steel sign structures
 - .4 Wood post sign structures
 - .5 Round steel sign structures
 - .6 Delineators
 - .7 Short duration counter stations
 - .8 Luminaire and sign poles with breakaway type bases
 - .9 Signal poles
 - .10 Service poles for small lighting projects
- .3 All structures listed under Paragraphs 503.1.2.2 to 503.1.2.8 are designed to breakaway upon impact. The designer shall attempt to locate these devices outside the clear zone.

CLEAR ZONE

503.2 REQUIREMENTS

- .1 The requirements for clear zones are defined in Section 620 of ministry Supplement to TAC Geometric Design Guide on the ministry web site at:

<http://www2.gov.bc.ca/gov/content?id=30E7C41CEA374DCAB2653CEA6359248B>

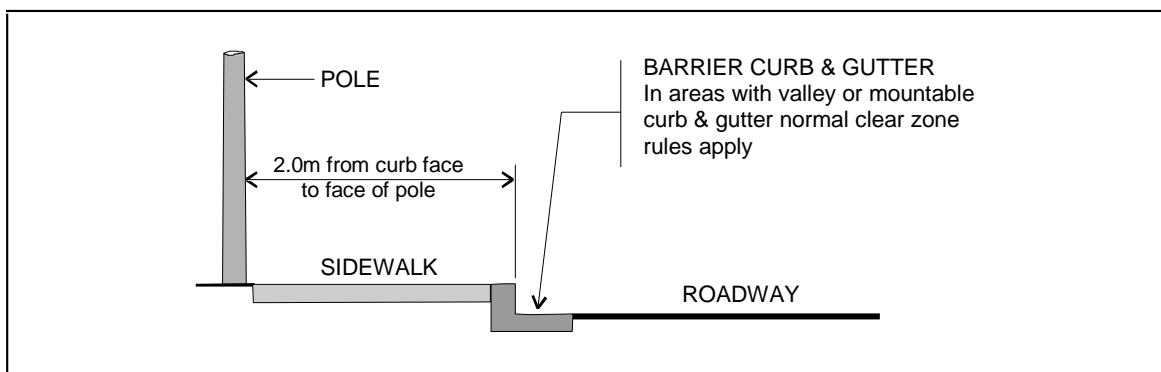


Figure 1. Clear zone in areas with barrier curb and gutter and posted speed of 60 km/h or less.

- .2 For electrical or signing designs that are part of a road works (civil engineering) project, electrical designers shall coordinate the protection of poles and structures located within the clear zone (unless frangible or breakaway bases are used) with the civil design engineer designer. Where a project has no road works reconstruction, designers shall ensure all poles and structures located within the clear zone are properly protected in the most cost effective manner. The type of protection (i.e. guardrail, frangible or breakaway base) must meet the approval of the ministry District Transportation Manager and the ministry Manager, Electrical Services.
- .3 Traffic controllers shall be located outside the clear zone.
- .4 Avoid locating luminaire and sign poles in narrow medians.
- .5 It is generally not practical to locate signal poles outside the clear zone. Signal poles should however be located a minimum of 1m from the face of curb. This shall include luminaire poles with signal equipment.
- .6 The clear zone shall apply to all applicable Municipal equipment installed within the ministry right-of-way.

504 ELECTRICAL DESIGN

504.1 LUMINAIRE POLES

- .1 As noted in Clause 504.5 wire theft is often an issue on ministry installations, specifically in Region 1. In Region 1 the designer should take steps to reduce wire theft by applying anti-theft techniques such as tamper-proof fasteners or commercially available products such as Wire Sentry™. Discuss options with the Manager, Electrical Services.
- .2 Standard ministry luminaire pole heights are 9.0 m, 11.0 m and 13.5 m. 7.5 m high luminaire poles may also be used to avoid conflicts with existing power lines. Refer to Section 300 when selecting luminaire pole mounting heights.
- .3 Standard luminaire poles are detailed in Section 635 of the ministry *Standard Specifications for Highway Construction*. For manufacturing details, refer to the ministry *Electrical and Signing Material Standards, Section 301- Traffic Signal, Luminaire and Sign Pole Structures*.
- .4 Service panels, pole mount traffic controller cabinets, and small signs under 750 mm wide x 900 mm high, may be mounted on luminaire pole shafts. Mounting for service panels, controllers, and signs are detailed on the electrical service installation drawings in Section 635 of the ministry *Standard Specifications for Highway Construction*. Note: Signs shall not be mounted on poles with service panels or traffic controllers.
- .5 For information on mounting equipment such as banners and receptacles refer to Appendix 500.3 and Appendix 500.4.
- .6 Field drilled holes up to 60 mm in diameter are permitted in luminaire pole shafts. When using a luminaire pole shaft with a Type 2C arm (double davit), all holes over 32 mm ϕ must be reinforced with a bushing as shown on the Service Panel Bushing Drawing SP635 – 2.4.17 of the ministry *Standard Specifications for Highway Construction*. This shall apply when installing a service panel, which requires a 60 mm diameter hole for chase nipple entry into the pole. Refer to Sub-Clause 504.4.11 for more information.

504.2 SIGNAL POLES

- .1 Standard signal pole dimensions, capacities, and installation details are illustrated in Section 635 of the ministry *Standard Specifications for Highway Construction*. Manufacturing details are shown in the ministry *Electrical and Signing Material Standards Manual, Section 301 - Traffic Signal, Luminaire and Sign Pole Structures*.

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- .2 Adding Load to existing traffic signal poles:
 - .1 Traffic signal poles shall not be overloaded more than 25 percent (i.e., combined stress ratio not exceeding 1.25).
 - .2 Pole loading shall be verified by the ministry's Pole Capacity Program. The spreadsheet is located in Appendix 500.1 and can be downloaded from:
http://www.th.gov.bc.ca/publications/eng_publications/electrical/electrical_and_traffic_eng/Electrical_Signing_Design_Manual/Section%20500/Appendix%20500/Appendix%20500.2/Pole%20Capacity.xls
- .3 Ministry standard signal poles and shafts and their usages are as follows:
 - .1 Type 1, 3, S, L and M signal poles are used for traffic signals. The designer shall choose the appropriate pole for the application based on pole loading. Primary signal heads, small signs, pedestrian heads, secondary heads, and pedestrian pushbuttons may be mounted on these poles.
 - .2 Type 4 and Type 4A shafts are used to mount secondary and pedestrian signals when the signal cannot be mounted on the shaft of the signal pole due to inadequate or impeded visibility.
 - .3 Type 2, 3, 4A and 5 shafts are used for mounting protected left turn signals in medians.
 - .4 Type 6 and 7 signal poles are no longer used and are replaced by Type S poles.
- .4 Efforts should be made to place poles behind sidewalks. Signal poles should be located at least 1m from the edge of raised island or curb.
- .5 Signal pole davits shall be oriented at 90 degrees to the centerline of the road except where the intersection is skewed. At skewed intersections designers shall ensure pole arms are oriented so they do not block other signal heads. This may involve orienting the signal arms as shown in Figure 1 to avoid signal head visibility conflicts. Using various combinations of standard signal pole equipment, pole arms can be made to span from 3m to 17m.

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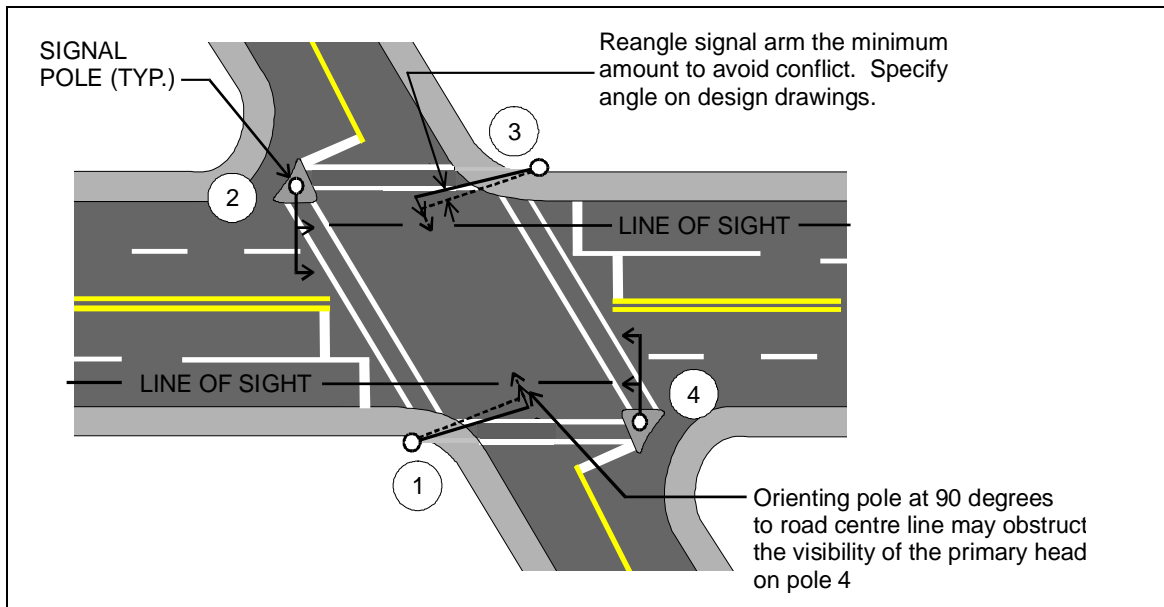


Figure 2. Signal arm orientation at skewed intersections

- .6 Locate poles to allow for easy access to pedestrian pushbuttons.
- .7 Select pole arm reach so that signal heads are either located over the center of the lanes or over the lane lines as described in Sub-Clause 402.6.4.
- .8 Designers should attempt to reduce the number of signal poles at intersections. One pole at each corner of an intersection is preferable; however, there are situations where additional poles must be used to improve the visibility of secondary and pedestrian signal heads and to reduce walking distance to pedestrian pushbuttons.
- .9 Designers shall use the most current version of the ministry's Pole Capacity Program to confirm the pole can support the required loading. The Pole Capacity Program is an Excel spreadsheet that calculates pole loading to confirm that the capacity of the pole is not exceeded. The Pole Capacity Program calculations are based upon the shaft type, arm type and length, signal head size, sign size, and the wind pressure for that area. A copy of the wind pressure tables can be found in Appendix 500.1.
- .10 Avoid mounting more than 4 signal heads on a pole shaft.
- .11 Use the formula in Figure 2 to calculate the signal arm lengths for Type L, M or S poles.

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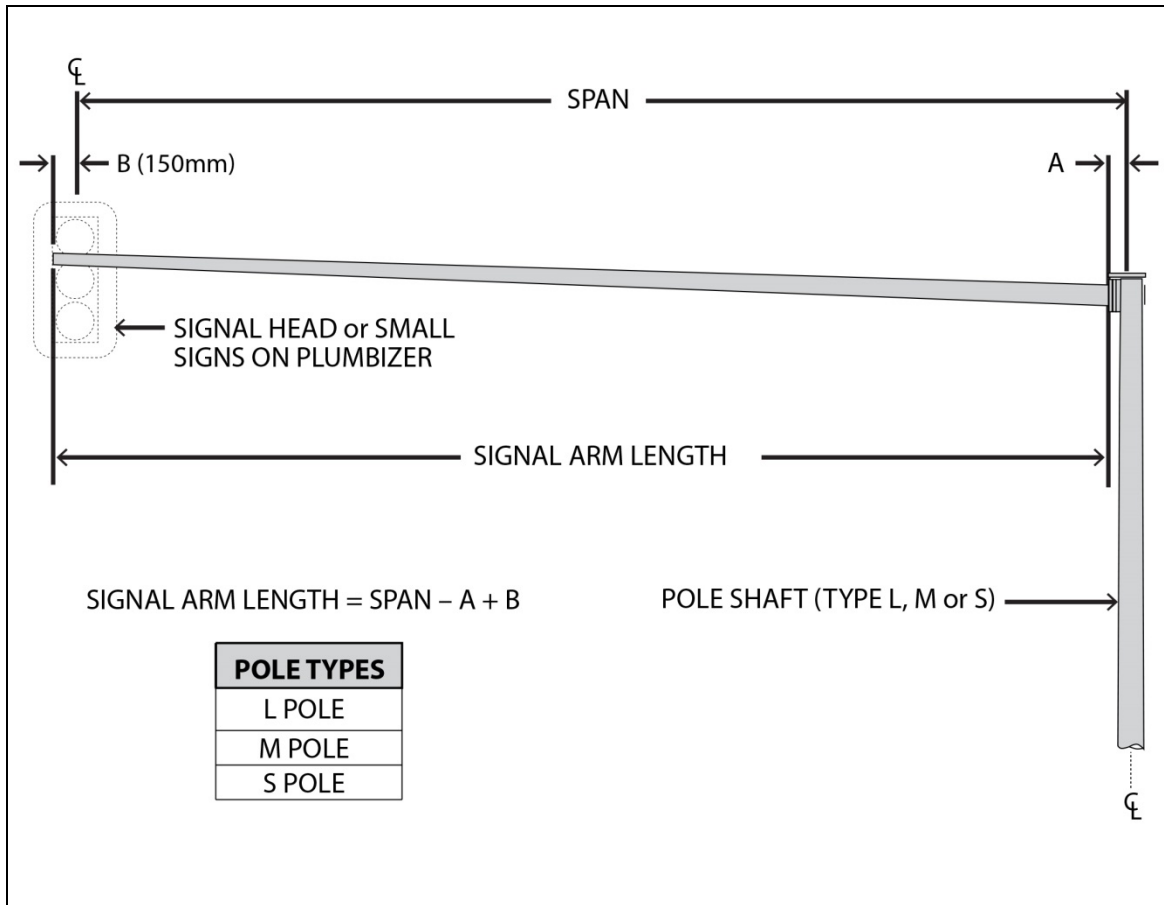


Figure 3. Method of calculating signal arm lengths for Type L, M and S poles

- .12 Where field drilled holes larger than 32 mm are required in signal poles, they shall be supplied with a reinforced bushing as shown on SP635 – 2.4.17 *Service Panel Bushing Detail* of the ministry *Standard Specifications for Highway Construction*. The bushing height will vary depending on whether it is an overhead or underground service (Refer to Sub-clause 504.4.10 for further information). Mounting service equipment on signal poles should be avoided where possible.
- .13 Street name signs are generally bolted onto signal pole arms. Designers shall locate the signs as noted in Figure 3. If signs cannot be positioned as illustrated, designers shall select the next most logical location, ensuring maximum sign visibility. In all cases, designers shall ensure the signs are located to avoid visual obstructions.

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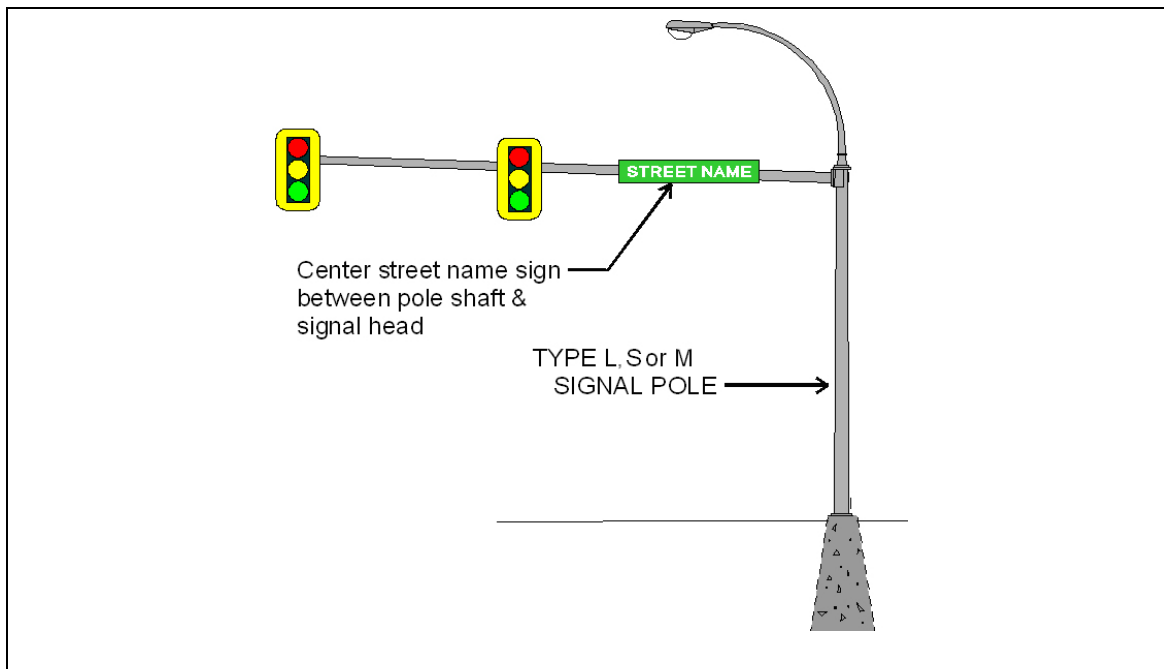


Figure 4. Positioning street name signs

- .14 Small traffic signs may be installed on signal pole arms. Refer to sign mounting drawings SP635-3.2.1 to SP635-3.2.6 in the ministry *Standard Specification for Highway Construction*. Signs shall be positioned 300 mm from the outside edge of the signal head backboard. Small signs (generally R-32, R-33L/R and R-34L/R lane use signs) may be mounted on sign poles positioned in advance of the intersection.
- .15 Designers shall ensure luminaire arms maintain required clearances from overhead power lines. Where clearance cannot be maintained the designer may consider a custom luminaire arm. Consult with ministry ITS and Electrical Engineering for suitable custom luminaire arms.

504.3 FRANGIBLE AND BREAKAWAY BASES

- .1 Frangible and breakaway bases are installed between the pole base-plate and the concrete base to reduce deceleration forces by allowing the pole to breakaway when impacted by a vehicle. Poles equipped with frangible bases may be located within the clear zone, however efforts should be made to locate poles outside of the clear zone.
- .2 Frangible bases are designed to accommodate:
 - .1 Type 2 6.5m shaft
 - .2 Type 2 8.5m shaft.

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- .3 Breakaway bases are designed to accommodate:
 - .1 Type 2 11.0m shaft.
 - .2 Type 1 pole.
 - .3 Type 3 pole.
 - .4 Shoulder mount sign structures.

This includes Type 1 and Type 3 poles with advance warning signs and guide signs, provided the sign dimensions are no greater than 2.44 m (W) x 1.22 m (H) and have a span from the pole shaft to the center of the sign of 3.1m or less based upon pole capacity calculations.
- .4 Frangible and breakaway bases should not be installed:
 - .1 On signal poles or overhead sign poles, except as stated in clause 504.3.3.
 - .2 At raised medians, raised islands, or crosswalks.
 - .3 Behind sidewalks in the clear zone, except in zones with a posted speed of 70 km/h or greater.
 - .4 Behind concrete barriers.
 - .5 On retaining walls or bridge structures.
- .5 Frangible and breakaway bases must meet the crash test requirements of NCHRP 350 *Recommended Procedures for the Safety Performance Evaluation of Highway Features*. There are two frangible bases listed on the ministry *Recognized Products List*: the Valmont-West Coast Engineering CS-300 and the Nova Pole International TB6-9. The use of the Valmont West Coast Engineering CS-300 is restricted as follows:
 - .1 The wind load design for the CS 300 frangible aluminum base shall be based on an ultimate moment capacity for the base of 34.8 kN-m.
 - .2 The CS-300 frangible base shall not be used for the 8.5 metre Type 2 shaft in combination with the Type 2C luminaire arm in geographic locations where the 25 year hourly mean wind pressure exceeds 580 Pa.
 - .3 All other standard configurations of Type 2 6.5m and 8.5m shafts and luminaire arms are acceptable in all areas of the province.
 - .4 Hourly mean wind pressures are given in CSA S6-14, Canadian Highway Bridge Design Code - Table A3.1.1.
- .6 Materials specifications for frangible and breakaway bases are detailed in the ministry *Electrical and Signing Materials Standards, Section 300 – Poles and Structures*.
- .7 Construction specifications for frangible bases are detailed in drawing SP635 – 2.1.15 *Aluminum Frangible Base for 9.0m and 11.0 Luminaire Poles* in the ministry *Standard Specifications for Highway Construction*.

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- .8 Construction specifications for breakaway bases used with poles are detailed in drawing SP635 – 3.1.5 *Breakaway Base for Advanced Warning and Directional Signs on Type 1 and 3 Poles* in the ministry *Standard Specifications for Highway Construction*.
- .9 Construction specifications for breakaway bases used with signs are detailed in drawings SP635 3.4.1 to 3.4.12 of the ministry *Standard Specification for Highway Construction*.

504.4 SERVICES

- .1 Standard ministry services may be overhead or underground and are as follows:
 - .1 30A (120/240V) single phase.
 - .2 100A (120/240V) single phase.
 - .3 30A (120/208V or 208/600V) three phase.
 - .4 100A (120/208V or 208/600V) three phase.
 - .5 30A (120/240V) single phase, metered.
 - .6 100A (120/240V) single phase, metered.
 - .7 30A (120/208V or 208/600V) three phase, metered.
 - .8 100A (120/208V or 208/600V) three phase, metered.
 - .9 Telephone services.
- .2 Standard services are detailed in drawings SP6352.4.1 to 2.4.20 of the ministry *Standard Specifications for Highway Construction*.
- .3 Standard services are described as follows:
 - .1 120/240V 100A panels have a 30A or 100A - 2 pole main breaker and space for up to 16 circuit breakers, 4 contactors, and 1 flasher control unit.
 - .2 120/208V and 347/600V 30A/100A panels have a 30A or 100A - 3 pole main breaker and space for up to 24 circuit breakers, 4 contactors, and 1 flasher control unit.
 - .3 120/240V - 30A panels have a 30A - 2 pole main breaker and space for up to 12 circuit breakers, 2 contactors, and 1 flasher control unit.
- .4 Standard circuit breaker sizes are:
 - .1 15A, 20A, and 30A single pole breakers are generally used for lighting circuits
 - .2 30A single pole breaker for traffic signals
 - .3 15A single pole breaker for PEC and flasher unit

ELECTRICAL DESIGN

- .4 40A single pole breaker for standard LED DMS signs.
- .5 Lighting contactors are size 1 - 4 pole type (30A).
- .6 30A service panels are primarily used for small installations such as 2 or 3 luminaires, overhead illuminated signs, flashing beacons, special crosswalks or web cameras.
- .7 Designers shall select the most cost-effective service voltage that is available. 120/240V 3-wire single phase or 120/208V three phase is normally used because it is readily available; designers shall consider 347/600V three phase for services with large loads and long branch circuit runs.
- .8 All service locations shall be confirmed in writing by the utility company.
- .9 All new and upgraded services require a meter. It is the responsibility of the Designer to consult with the power utility to confirm whether or not the required power service is available.
- .10 Service panels may be installed on all Type 2 (excluding poles with 2C arms), 4, 4A and Type 5 shafts. All other shafts supporting a service panel must be supplied with a bushing to reinforce the chase nipple hole from the service panel to the pole. The service panel bushing is detailed in drawing SP635 – 2.4.17 *Service Panel Bushing Detail*, of the ministry *Standard Specifications for Highway Construction*. The bushing height will vary for an underground or overhead service.
- .11 Where possible, designers shall avoid locating services on signal poles with pushbuttons, poles in traffic islands, sign poles, and poles with frangible bases. Instead, designers shall consider locating the service on a separate pole outside the clear zone. Position the service pole in a location least susceptible to being hit. Refer to Chapter 503 for more information on clear zone.
- .12 Designers shall consider the following when locating service panels.
 - .1 Proximity to power pole.
 - .2 Orientation of panel - locate on downstream side of the pole in accordance with SP635-2.4.20
 - .3 Maintenance pad – ensure concrete maintenance pad can be constructed level and will not slump off down a slope (Refer to SP635-2.4.20).
 - .4 Ease of access for maintenance - where possible try to locate at the same corner as the traffic controller and take into consideration possible snow accumulation.
 - .5 Obstruction to public.
 - .6 Safety of maintenance staff and the public.

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- .13 The majority of services are overhead. Underground services should be considered in major urban and commercial areas, and in areas where municipal bylaws do not allow overhead wiring. If designers are unsure of the type of service to use consult ministry Electrical and ITS Engineering.
- .14 For underground services fed from a power utility pole or pad mount transformer a service disconnect panel shall be used when the distribution panels are over 100m away from or out of sight of the power utility service pole which is feeding the panel.
- .15 Service disconnects shall not be mounted on power utility poles.
- .16 All services shall be grounded with a ground plate as detailed on the drawing SP635-2.4.18 *Ground Plate Installation Detail*, Section 635 of the ministry *Standard Specifications for Highway Construction*.
- .17 Communications services are required only when specifically requested by the design engineer. Communications services are typically provided by cellular data network, however alternate means such as land-line, cable, or fibre-optic may be considered based upon availability. Procurement and account set-up of cellular modems must be done through the ministry Telecommunication Analyst. No panel or cabinet shall be mounted on a utility pole.
- .18 347/600V services may be permitted for electrical installations where the loads are too large to economically accommodate 120V services. These installations include large tunnels, large lighting systems, swing bridges, highmast lighting systems, and others. The use of 347/600V must be approved by ministry Electrical and ITS Engineering.
- .19 Where 347/600V services are used the following is required:
 - .1 Provide aluminum plates with black engraved letters indicating “347/600V” on all pole hand-hole covers, panels and junction box lids. Labels should be located in easy to read locations.
 - .2 Local disconnect shall be provided at each electrical device except luminaires.
 - .3 Circuits shall be bundled and tagged with Lamacoid™, or equivalent, labels indicating the circuit numbers.
 - .4 Review the requirements for additional tagging and labeling with ministry Electrical and ITS Engineering.

504.5 WIRING

- .1 ministry electrical systems are generally wired with RW90 (XLPE) stranded copper conductors except for any non-traffic signal conductors in Region 1

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which may be RW90 aluminum to reduce wire theft. The aluminum conductors generally include, however are not limited to:

- .1 Service conductors.
 - .2 Street lighting.
 - .3 Traffic counters.
 - .4 Control cabinets.
 - .5 Any other branch circuit loads.
- .2 Aluminum wire, although lighter and less expensive than copper, has a lower ampacity rating than copper and requires a larger conductor for a given current capacity. When using aluminum wiring ensure all standard industry procedures are followed and applicable details are provided on the electrical drawings. Note that:
- .1 Aluminum wiring is generally available in #6 AWG or larger gauge sizes.
 - .2 Aluminum wire shall not be used in circuits inside of poles: All wiring up poles shall be RW90 stranded copper.
 - .3 All terminals and connection points shall be rated for both copper and aluminum (AL/CU).
 - .4 Specify Burndy™ type crimp-on connectors and tape over and duct seal connections as per split bolt connector method noted in ministry Standard Specification Section 635.19.
 - .5 Specify the use of an antioxidant compound such as Pentrox™ on all wire connections and terminations.
 - .6 Wiring details are outlined in drawings SP635-2.5.1 to SP635-2.5.10 in the Standard Specification for Highway Construction.
- .3 Signals shall use signal cable for the signal conductors if directed to do so by Electrical and ITS Engineering. Signal cable shall run from the controller to a pole or poles at given corner of the intersection.
- .4 Signal cable is detailed on drawing SP635- 2.5.9 *Signal Cable Wiring and Colour Coding* in Section 635 of the ministry *Standard Specifications for Highway Construction*. All signal conductor splices shall be made in the pole hand-holes.
- .5 Traffic signal / railway signal interconnects shall use a six-wire double break and supervisor circuits.
- .1 In the traffic signal control cabinet, relays should normally be in opposite states with or without a train approaching. If both relays are energized or both de-energized, the interconnect cable may be cut or shorted and the traffic signal should be programmed to implement track clearance green followed by all-red flash.

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- .2 The double-break circuit resolves the issue of a short circuit between two wires in the interconnect cable.
- .3 The supervisor circuit resolves the issue of a cut or disconnected interconnect cable.
- .4 In retrofits, one additional relay is required in the traffic signal cabinet. The railroad cabinet continues to use a single relay.
- .5 A track clear green time is required to avoid preempt trap because there is no gate down circuit.
- .6 See Figure 5 and Table 1 below for details on the interconnection.

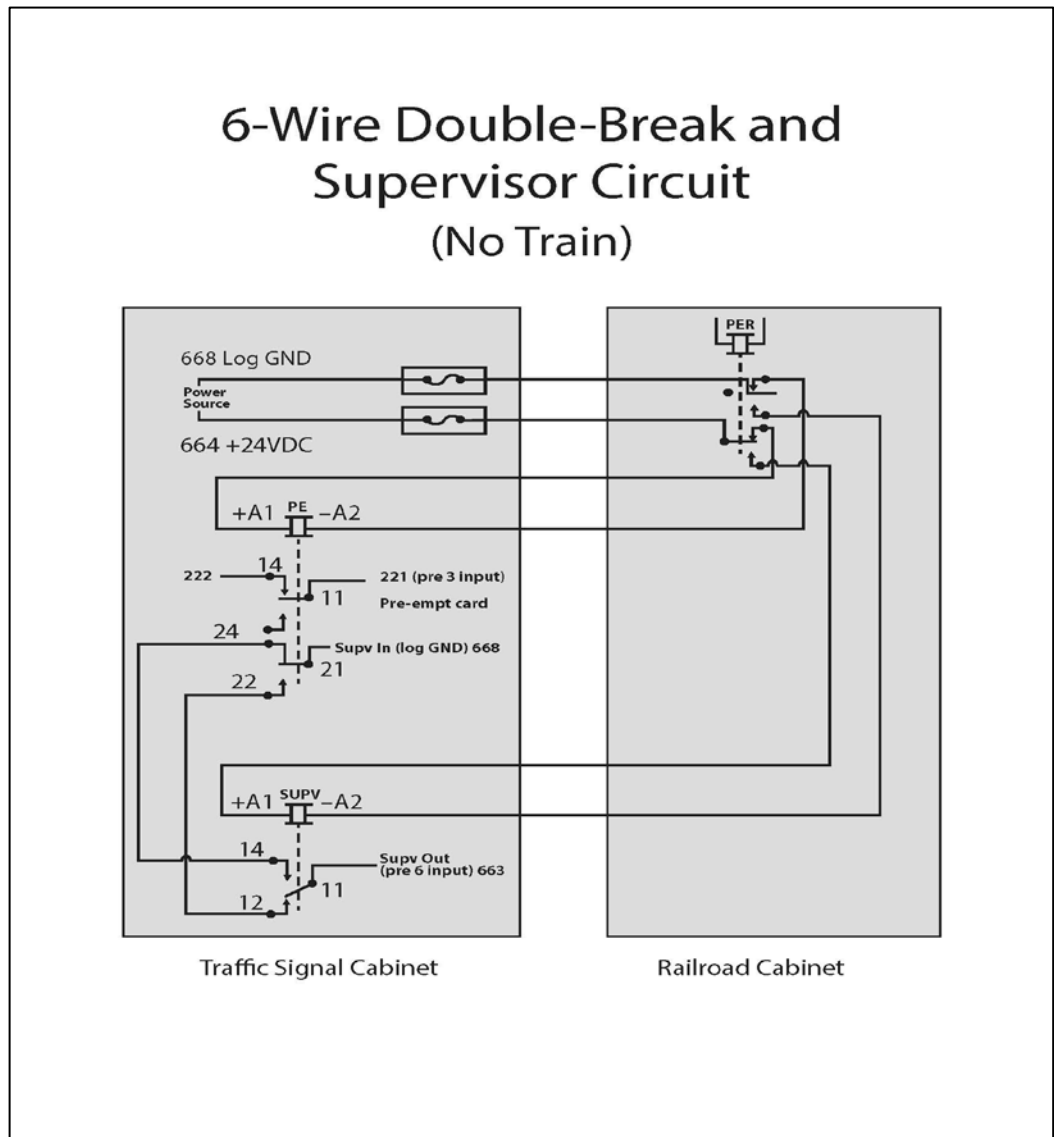


Figure 5: Traffic Signal - Rail Signal Interconnect Circuit

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CONTROLLER ASSEMBLY INTERCONNECT CABLE <CAIC*>					
			BELDON 9388	IMPULSE 181804	TERM
POWER FROM TRAFFIC CONTROLLER TO RAIL CABINET	PAIR 1	1-1	(BLACK)	(BLACK)	CB8-1
		1-2	(RED)	(RED)	CB9-1
		SHIELDING			*
K50 RELAY PE ENERGISED	PAIR 2	2-1	(BLACK)	(BLACK)	K50-A2
		2-2	(RED)	(BLUE)	K50-A1
		SHIELDING			*
K51 RELAY SUPV	PAIR 3	3-1	(BLACK)	(BLACK)	K51-A2
		3-2	(RED)	(YELLOW)	K51-A1
		SHIELDING			*
*	PAIR 4	4-1	(BLACK)	(BLACK)	*
		4-2	(RED)	(WHITE)	*
		SHIELDING			*

Table 1: Traffic Controller to Rail Controller Interconnect Cable

- .6 All wiring shall conform to the requirements of the Canadian Electrical Code.
- .7 Other types of wiring used on ministry projects are as follows:
 - .1 SOW Cable is generally used from post mounted flashers to the junction box adjacent to the flasher and from sign luminaires to the junction box mounted on the pole arm.
 - .2 Teck Cable may be used for temporary wiring in areas where the wiring requires mechanical protection such as on poles, walls, bridges, etc. Teck cable may also be used for surface installations on bridges and for service feeds. Teck cable may also be direct-buried to prevent wire theft.
 - .3 Signal Cable may also be used for temporary overhead wiring of traffic signals.
 - .4 Triplex or Quadruplex may be used for temporary overhead street light wiring.
 - .5 Shielded Cables is generally used for vehicle detector loops at traffic signals, for telephone feeds from traffic controllers to telephone demarcation panels, and for hardwire interconnecting traffic controllers.

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- .8 All metal equipment installed must be connected to a common bonding conductor which shall tie into the service panel. Bond conductors shall be green and sized in accordance with the Canadian Electrical Code. Where a branch circuit is over 1000 m in length, designers shall perform a ground fault calculation to ensure the bond conductor is properly sized.
- .9 All single conductor wiring shall be supplied in the colours noted in drawing SP635-2.5.7 *Single Conductor Colour Coding* of the ministry *Standard Specifications for Highway Construction*.
- .10 All wiring circuits shall be protected with circuit breakers located in the service panel. In addition, luminaire circuits are protected with a 10A in-line fuse located in the pole hand-hole as noted on drawing SP635-2.5.6 *Luminaire Wiring in Pole Hand-hole* in the ministry *Standard Specifications for Highway Construction*. Luminaires installed on bridges and walls shall have the 10A in-line fuses installed in the nearest junction box.
- .11 Designers shall use minimum size wiring, while allowing for maximum voltage drop and load, to increase cost effectiveness. This may involve multiple wire sizes in any given branch circuit. Where branch circuit extension may be required in the near future, the wiring shall be sized to accommodate the increased loads. Voltage drop and load are further explained in Clause 504.6.
- .12 Typical types of branch circuits fed from a service panel and preferred wire sizes are as follows:
 - .1 Luminaires – Up to No 10 (AWG)
 - .2 Traffic controllers - No 10 (AWG)
 - .3 Island flashers - No 14 (AWG) copper or No 6 (AWG) aluminum
 - .4 Photocells- No 14 (AWG)
 - .5 Flashing beacons - No 14 (AWG)
 - .6 Small ITS installations - No 14 (AWG).
- .13 Typical types of circuits fed from a traffic controller and preferred wire sizes are as follows:
 - .1 Signals - No 14 (AWG)
 - .2 Signal Neutral - No 12 (AWG) for main conduit runs around intersection
 - .3 Advance warning flashers - No 14 (AWG)
 - .4 Fire indication lights - No 14 (AWG)
- .14 Designers are responsible for ensuring the load and voltage drop are within the allowable values.
- .15 Typical 120/240V luminaire branch circuit wiring is as shown in Figure 4.

ELECTRICAL DESIGN

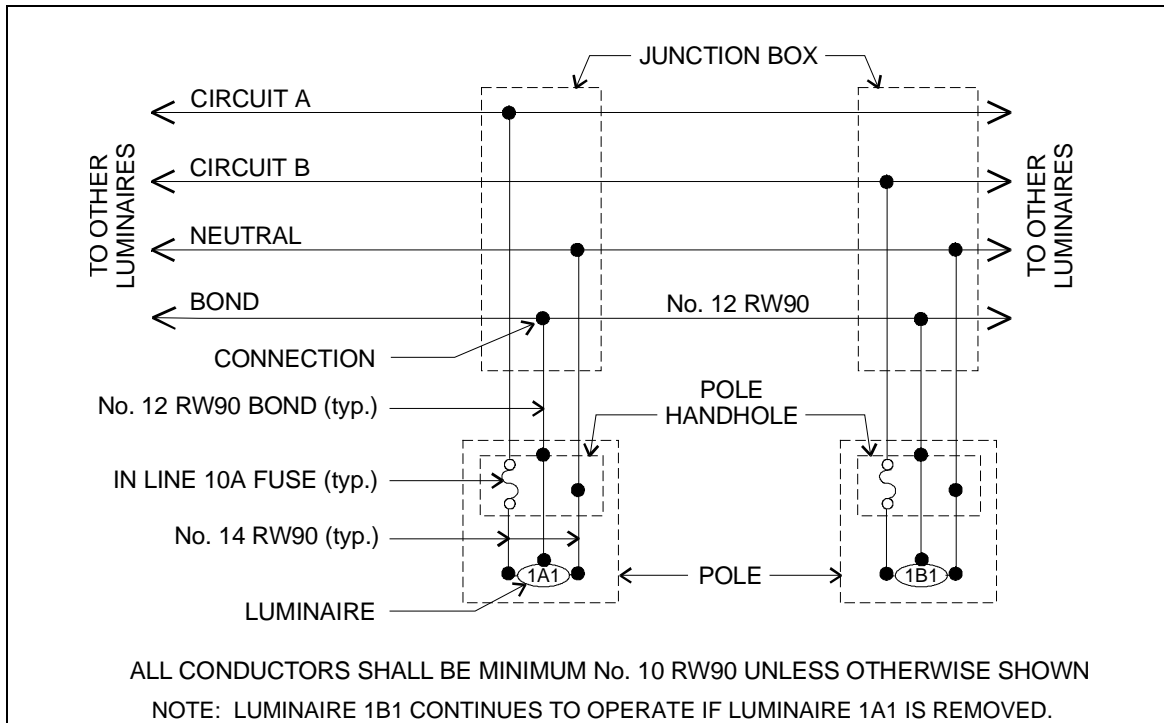


Figure 6. Typical 120/240V luminaire branch circuit wiring

- .16 If the service will not be expanded beyond two luminaires, lighting circuits may be wired through the photocell without the use of a contactor. The wiring is like that shown on Figure 4 except that circuit B is removed. A contactor is not required.
- .17 Typical 120V traffic signal branch circuit wiring is as shown in Figure 5. For signal cables, no splices are permitted in junction boxes.

ELECTRICAL DESIGN

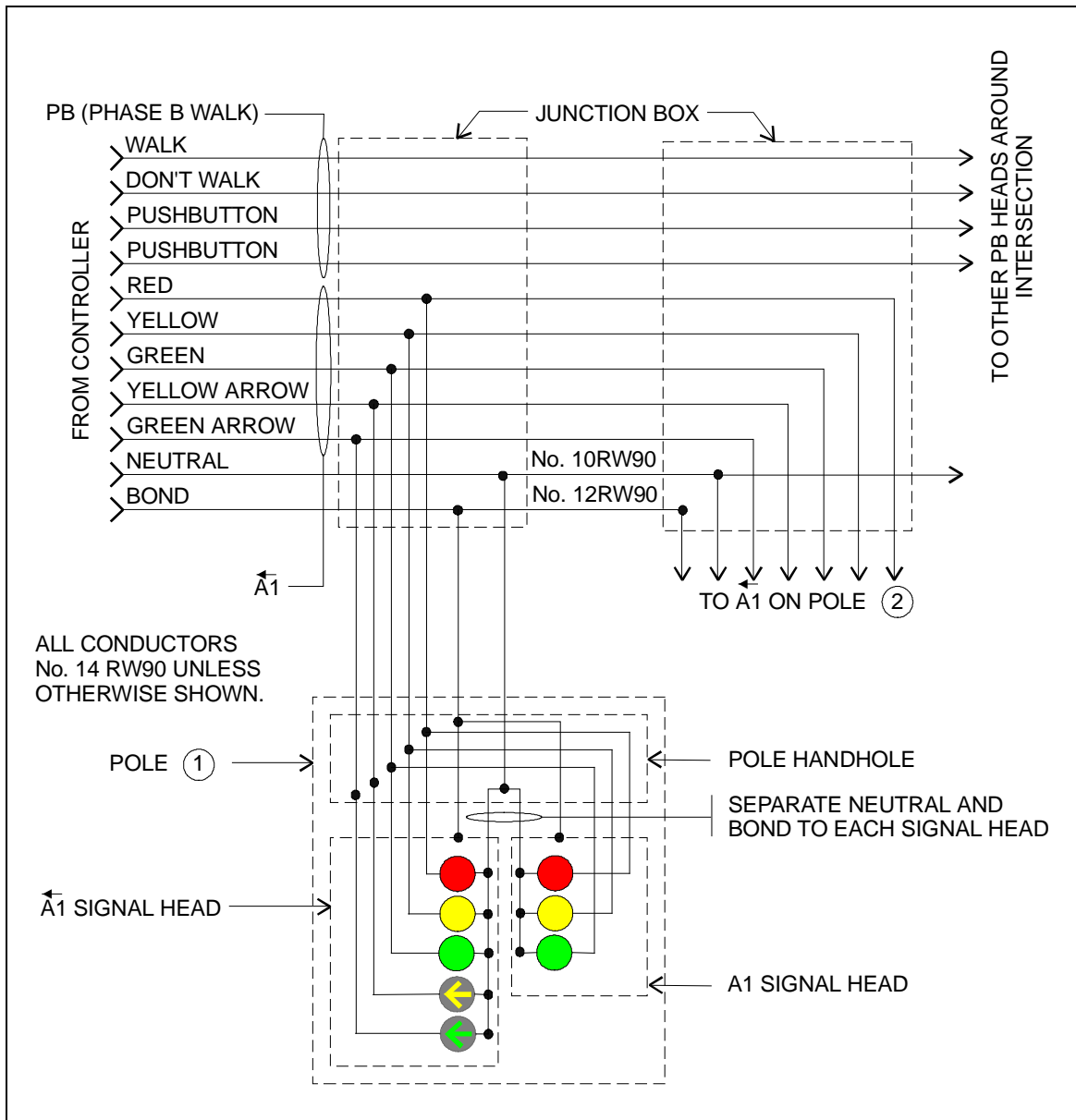


Figure 7. Typical 120V traffic signal circuit wiring (for single conductor)

504.6 VOLTAGE DROP AND LOAD CALCULATIONS

- .1 Designers shall submit voltage drop and load calculations with the Design Folder (see Section 200) as required
- .2 Allowable branch circuit voltage drops are as follows:
 - .1 Lighting circuits shall not exceed 4 percent, except where there is absolutely no chance for expansion, then 5 percent may be acceptable if approved by ministry Electrical and ITS Engineering.

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- .2 All other circuits, including traffic controllers, post-mounted flasher luminaires, etc., shall not exceed 3 percent.
- .3 Where an underground service is used, the voltage drop from the main breaker in the disconnect panel to the main breaker in the distribution panel shall be calculated and added into (and form part of) the voltage drop for each branch circuit.
- .4 Conductor and resistance data are listed in Table 1. The D-C resistance at 25° C represents a realistic temperature value for conductors buried in earth. Designers shall note that $R_{ac}/R_{dc}=1$ for circuits with wire sizes between number 14 and 2/0 in non-metallic conduit, therefore, the following examples use the term resistance rather than impedance. To simplify calculations, it is assumed that the luminaire power factor equals one.

AWG WIRE SIZE	NUMBER OF STRANDS	NOMINAL DIAMETER (mm)	D-C RESISTANCE OHMS/km AT 25°C
14	7	1.84	8.63
12	7	2.32	5.41
10	7	2.95	3.42
8	7	3.71	2.15
6	7	4.67	1.34
4	7	5.89	0.850
2	7	7.42	0.531
1	19	8.18	0.423
1/0	19	9.47	0.335
2/0	19	10.62	0.266
* R_{ac}/R_{dc} Ratio = 1 for #14 to 2/0 wire in non-metallic conduit.			

Table 2. Copper conductor and resistance data

- .5 Designers shall check the loads on the main breaker and the branch circuits. If loads on the main breaker are high and over 8 branch circuits are being used then a Load Summary Table should be added beside the wiring diagram on the electrical drawings. Refer to the example load sheet in Table 2 below.

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LOADS AT SERVICE NO.			
PHASE (RED)		PHASE (BLACK)	
A(1)	A	B(1)	A
C(1)	A	D(1)	A
A(2)	A	B(2)	A
C(2)	A	D(2)	A
E	A	F	A
Traffic Controller	A	Flasher	A
Total	A	Total	A

Table 3. Example load summary table

504.7 TRAFFIC COUNT STATIONS

- .1 Traffic count stations are used to obtain vehicle count data. The stations consist of vehicle detectors and traffic counter devices.
- .2 There are two types of traffic counter stations:
 - .1 Short duration traffic count stations are required for part time data collection only. A loop based example is detailed on drawing SP635-2.6.1 *Short Duration Traffic Counter Station Installation Drawing* in the ministry *Standard Specifications for Highway Construction*. Other detection methods may be considered.
 - .2 Permanent traffic counter stations are required for full-time data collection. Communications will be required at each permanent Traffic Counter Station for remote access. Refer to drawing SP635-2.6.2 *Permanent Traffic Counter Installation Drawing* in the ministry *Standard Specifications for Highway Construction* for a loop based example. The ministry has no specific standards for the traffic counter however the Golden River Marksman 660/680/720™ and IRD Traffic Ace™ are commonly used. The cabinet and counter along with procedures for testing set-up and commissioning of the traffic counters should be confirmed with the ministry Traffic Data Program Technician prior to design.

504.8 POST MOUNTED FLASHERS

- .1 Post mounted flashers are intended to be used as supplements to Keep Right/Left Signs (R-14R/L) and Object Marker warning signs (W-54L/R/D).

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The flasher is an auxiliary device used to accentuate the object marker warning sign typically at the ends of continuous sections of median barrier, raised median islands or other fixed objects.

- .2 Posted mounted flashers are not required in low speed zones (60 km/h or less) when an object marker sign is used. A post-mounted flasher may be used where a particular site has a documented accident history related to the road feature, as directed by the ministry Senior Traffic Operations Engineer.
- .3 In locations with a posted speed of 70 km/h or greater, post mounted flashers are only required in areas not illuminated, unless otherwise directed by the ministry Senior Traffic Operations Engineer. If power is not available or the cost to supply power is prohibitive, an approved solar or battery powered flasher may be used. Alternately, an object marker constructed from reflective sheeting may be used.
- .4 Where flashers are required at impact attenuators or crash barrels, the preferred flasher post and sign mounting locations are as shown in Figure 6.

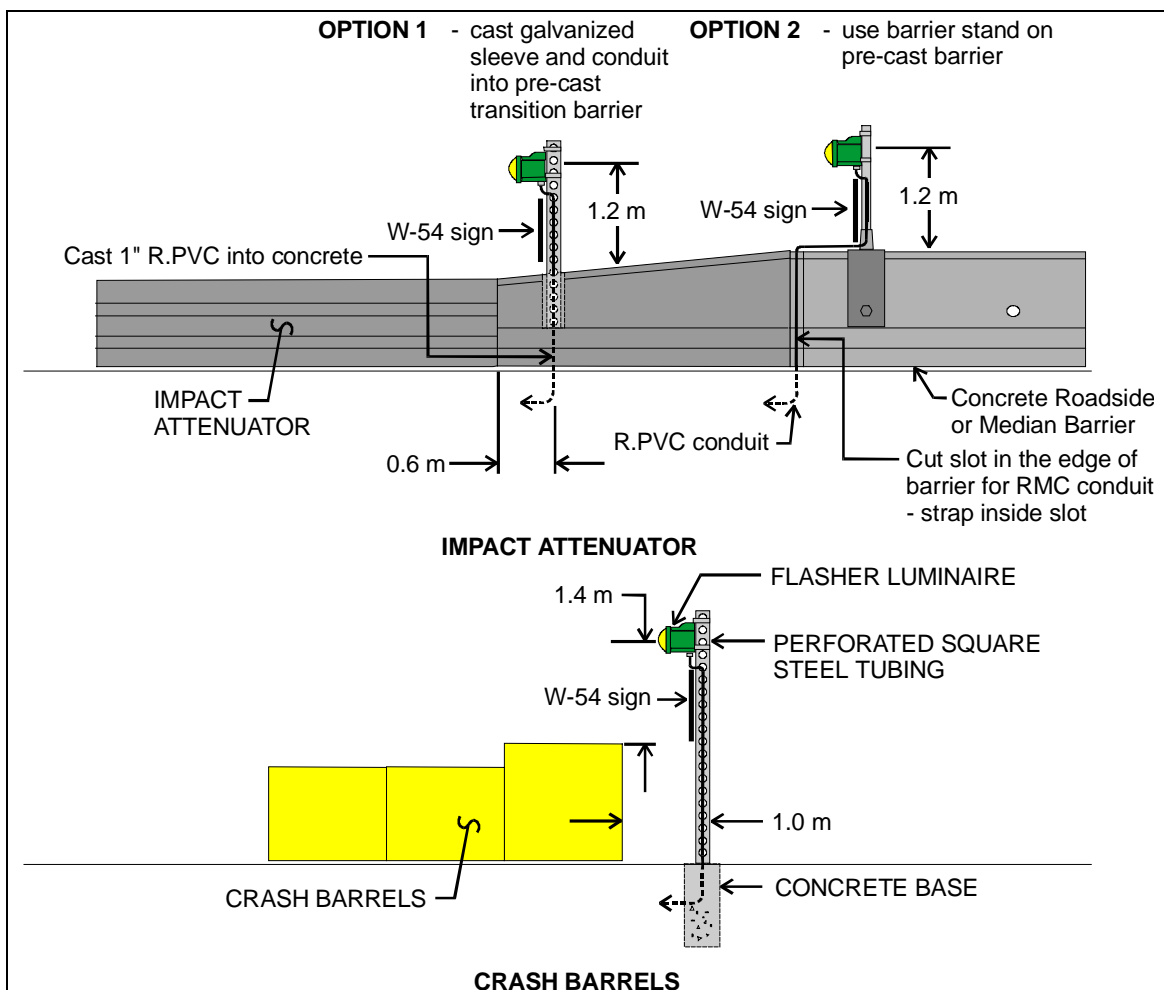


Figure 8. Flasher locations at impact attenuators or crash barrels

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- .5 Flasher installation details on perforated square steel tubing are detailed in drawings SP635-2.9.1 to SP6352.9.6 *Flasher Luminaire Installation Details* of the ministry *Standard Specifications for Highway Construction*. Flashers may also be installed on steel poles as detailed in the drawings referenced above.
- .6 Flashers:
 - .1 Are controlled by a 120V flasher control unit located in the service panel. The flasher control unit has two output circuits with a maximum 10A load for each output.
 - .2 Flash at a rate of 60 flashes per minute with a symmetrical (50%) duty cycle.
 - .3 Use LED technology.
- .7 Flashers and signs must be shown, with the corresponding sign number, on the electrical drawings (e.g.: W-54L, R-54D, R-14R).
- .8 Flashers with their related signs shall also be shown on the signing and marking site plan drawings. They shall be labeled “*For Information Only*” on the signing and marking drawings as they will be installed by the electrical contractor and maintained by the Electrical Maintenance Contractor. Where signs are installed with no flashers they shall only be shown on the signing and marking site plan drawings and will be installed by the Signing Contractor and maintained by the Area Road and Bridge Maintenance Contractor.

505 SIGN SUPPORT STRUCTURES

505.1 GENERAL

- .1 This chapter shall be read in conjunction with the ministry *Manual of Standard Traffic Signs and Pavement Markings*.
- .2 Signs shall be manufactured out of extruded aluminum or sheet aluminum. For a comprehensive listing of sign sizes and substrates, refer to the latest edition of the ministry *Traffic Signs Catalog* or consult the Senior Traffic Operations Engineer. In most cases, extruded aluminum signs are manufactured in standard widths, from 2440 mm to 7320 mm in increments of 610 mm. Heights are in increments of 305 mm.

505.2 SIGN POLES

- .1 Standard sign poles are detailed in the sign pole and sign mounting drawings in the ministry *Standard Specifications for Highway Construction*. Drawings show typical small overhead signs up to 0.9 m wide x 1.20 m high mounting hardware and mounting details. Large sign installation drawings show overhead signs larger than 0.9 m wide x 1.2 m high mounting hardware and mounting details. Small signs are typically mounted on a signal pole arm. Refer to Paragraphs 504.2.13 and 504.2.14 for more information. For sign pole manufacturing details refer to the ministry *Electrical and Signing Material Standards, Section 301 - Traffic Signal, Luminaire and Sign Poles*.
- .2 Ministry Standard Galvanized Steel Sign Poles are as follows:
 - .1 Type 3 sign poles may be used for signs up to 2.44 m wide x 1.22m high. These poles can be mounted on a breakaway type base and located within the highway clear zone. Refer to Chapter 503 for more information on clear zone. The ministry has made a risk management decision to accept pole loading on Type 3 sign poles that do not extend over the traveled portion of the road (see Figure 8). Type 3 sign poles with advance warning signs shall not be overloaded by more than 31 percent (i.e. combined stress ratio not exceeding 1.31). Note: Existing Type 3 signal poles shall not be overloaded more than 25 percent (i.e. combined stress ratio not exceeding 1.25). Pole loading shall be verified with the ministry Pole Capacity Program.
 - .2 Type S, L, M and H sign poles are the most commonly used poles for mounting overhead extruded aluminum guide signs. Type 1, 3, S, or L poles are most commonly used for mounting sheet

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- aluminum traffic signs. No breakaway device exists for Type S and Type L poles.
- .3 Type 6 and 7 sign poles are an old ministry standard and should no longer be used except for replacement of existing.
 - .4 Type 6, 7, S, L, M and H poles must be protected by concrete roadside barriers or installed outside of the clear zone. Refer to Clause 503.2 for more information on protection and clear zone.
 - .5 Type 1 and 3 poles may be mounted on a breakaway base, thus can be installed in the clear zone. For more information on Breakaway bases, refer to Clause 504.3.
- .3 It is not permitted to locate sign poles in medians less than 1.3 m wide.
 - .4 Where field drilled holes larger than 32 mm in diameter are required in Type 1, 3, 6, 7, S, L, M, and H, the poles shall be reinforced with a bushing as shown on drawing SP635-2.4.17 *Service Panel Bushing Detail* in the ministry *Standard Specifications for Highway Construction*.
 - .5 Small signs such as R-80 to R-84 lane use signs shall be mounted on Type 1, 3, 6, 7, S, L or M signal type poles in advance of the intersection. These signs must be mounted on the signal pole arm using ministry standard mounting hardware. Refer to Paragraph 504.2.14 for more information on typical sign mounting hardware.

SIGN SUPPORT STRUCTURES

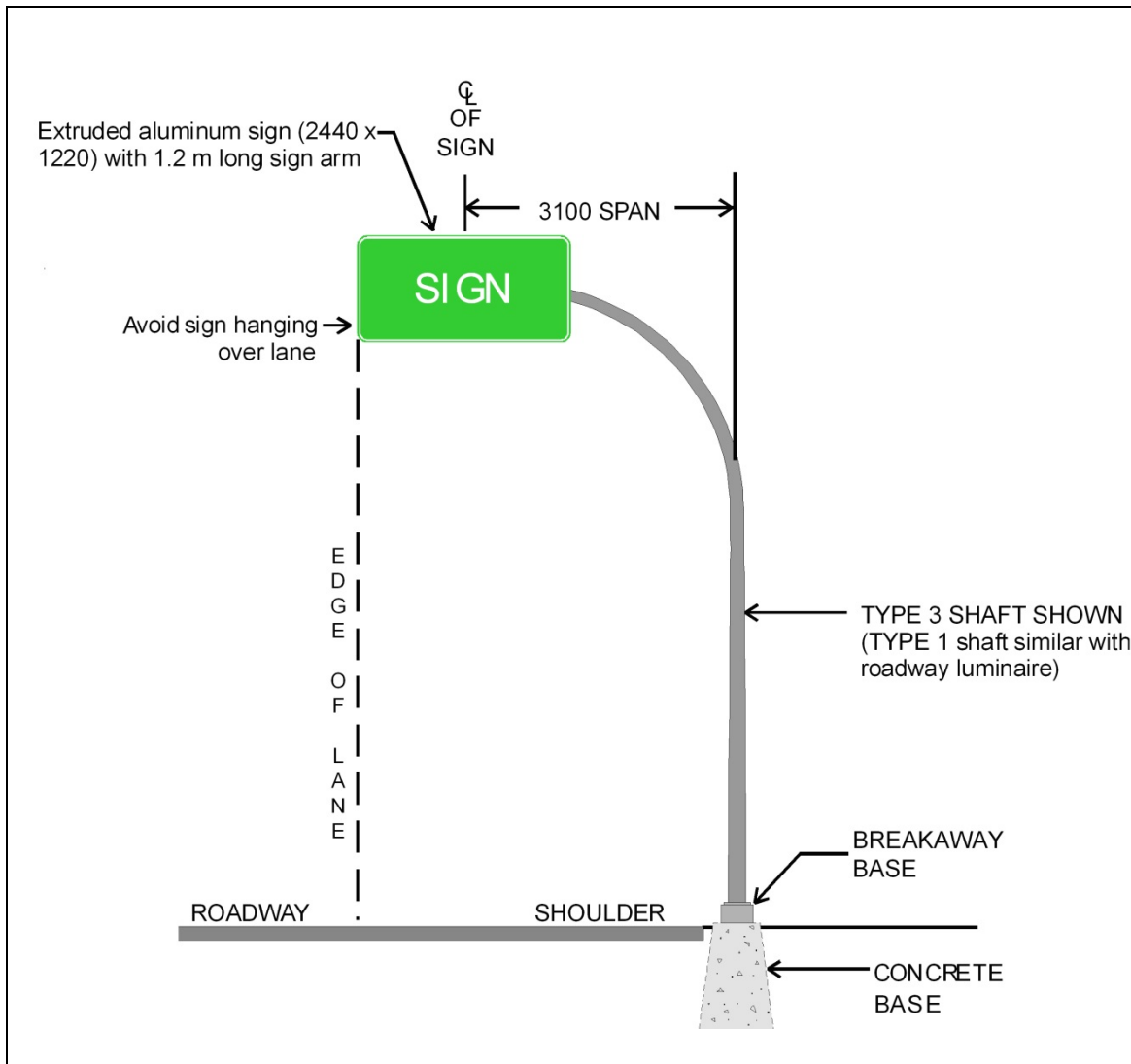


Figure 9. Type 3 sign pole

- .6 Where pole loading is in question, designers shall use the most current version of the ministry's Pole Capacity Program to confirm the pole can support the required sign loadings. The Pole Capacity Program is an Excel spreadsheet allowing designers to determine the type of pole required by entering the sign area, span, and the wind pressure for that area. Wind pressure tables and pole capacity program may be found in Appendix 500. Users of this program must have basic knowledge of ministry standard equipment and structural design.
- .7 Use the formula in Figure 8 to calculate the sign arm length for an L, M or H pole.

SIGN SUPPORT STRUCTURES

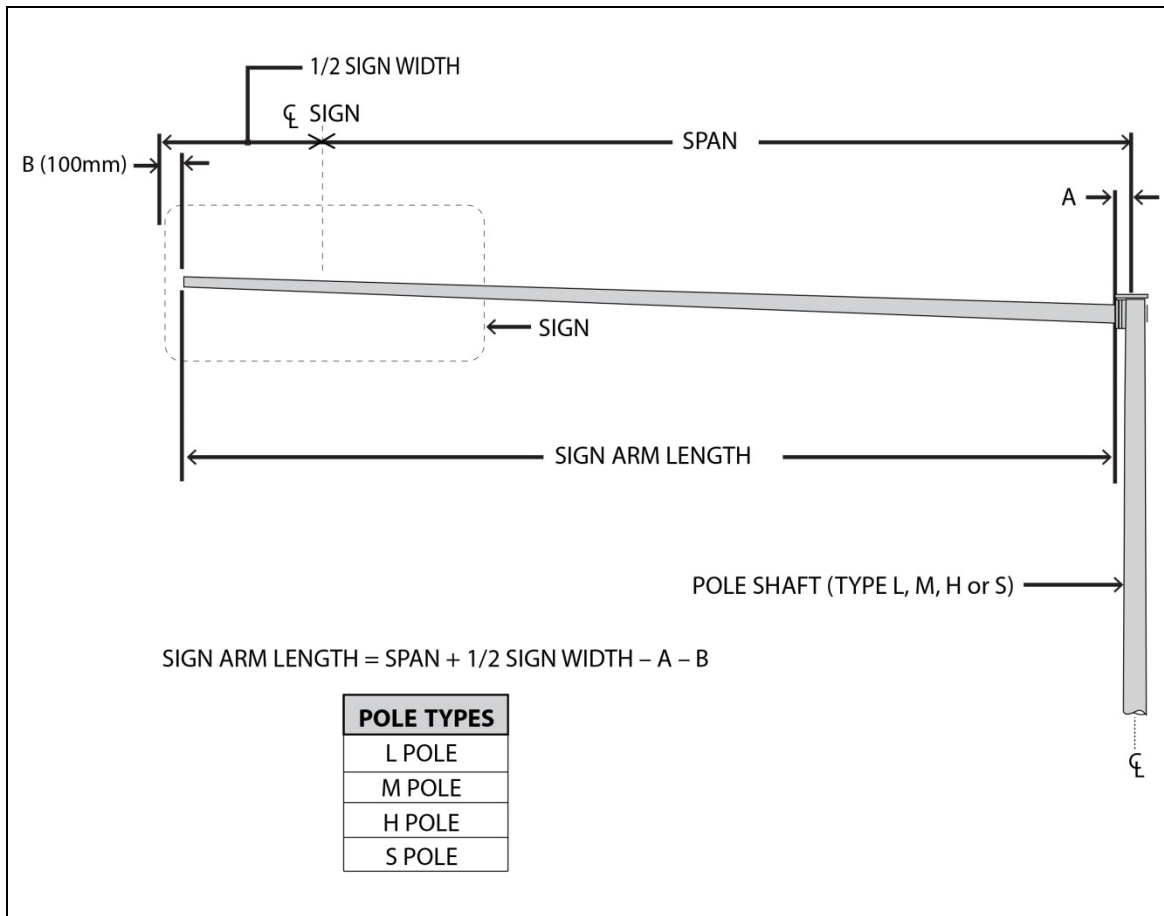


Figure 10. Method of calculating sign arm length

- .8 Detailed elevations are required for each pole structure in accordance with Clause 708.8.
 - .1 Elevations for sign poles with electrical equipment shall be shown on the electrical drawings.
 - .2 Elevations for sign poles without electrical equipment shall be shown on the signing and pavement marking drawings.
 - .3 If the electrical and signing and pavement marking designs for a project are done by different firms, the designs shall be well coordinated to maintain consistency.
- .9 Where a Type H sign pole is not capable of supporting the required sign size, designers shall use a custom sign structure.

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505.3 CANTILEVER AND SIGN BRIDGE STRUCTURES

- .1 Cantilever and sign bridge structures are custom structures designed to suit specific locations. General details on these structures can be found in the ministry *Electrical and Signing Material Standards Chapter 306 - Cantilever and Sign Bridge Structures*. A number of generic structures have been developed and are shown in the *Electrical and Signing Material Standards*. A list of these structures and their general applications are as follows:
 - .1 Cantilever Truss Structure have two horizontal chords (tied together to form a truss) and a single vertical support leg. This structure is generally used to reach up to 14 m, from center of leg to outside edge of sign.
 - .2 Monotube Sign Bridge Structure - this structure has a single horizontal chord and two vertical legs. This structure is generally used for spans greater than 14 m where the sign height is less than 2.44 m.
 - .2 Truss Sign Bridge Structure has two horizontal chords (tied together to form a truss) and two or three sets of vertical legs. This structure is generally used for spans over 14 m where ultimate design sign height is over 2.44 m high. For excessively long spans a center leg can be used on the median barrier. The vertical support legs may consist of single or double shafts. The advantage of 2 vertical shafts at each leg is the shaft diameters can be reduced thus reducing the impact on the median barrier width.
- .2 When selecting a cantilever or sign bridge structure, designers shall choose the most cost effective sign structure to suit the installation.
- .3 The basic design process for sign bridge or cantilever structures is as follows:
 - .1 The sign locations, messaging, initial and ultimate areas should be confirmed in consultation with the Senior Traffic Operations Engineer. Generally sign structures are sized to allow for additional signs and expansion of sign messages. A general rule of thumb is to allow an additional 610 mm to the proposed sign heights and allow for full width signage from edge to edge of the pavement.
 - .2 Prepare the sign structure elevation drawing in accordance with the generic DS series drawing located in Appendix 700.1. This drawing shall show the final road elevation cross-section details, underground or overhead utilities, structure dimensions, sign positioning, and initial and ultimate sign areas, and structural design criteria. Where using a truss type structure, the tubes are generally spaced (center to center) 1/2 the ultimate sign height.

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- .3 If required, prepare an appropriate barrier flare design around the support legs of the structure.
- .4 Designers must confirm final elevation dimensions and modify the sign structure elevation drawings(s) to reflect the final elevations and key dimensions.
- .5 Confirm vertical leg diameters, number of anchor bolts and anchor bolt spacing.
- .6 Prepare sign structure foundation design drawing. The process will involve both structural and geotechnical engineering. The CAN/CSA-S6-14 Canadian Bridge Design Code design criteria only shall be used. The structural engineer shall confirm the base reaction forces based upon the pole elevation as noted above. The geotechnical engineer will design the foundation shape, size and depth of bury based upon the base reaction forces and the soils present. Typically foundations will be spread footing type however poor soils may require a piled design. Once the geotechnical engineer defines the type of base and size, the structural engineer shall prepare a drawing showing all information required to construct the base. The drawing shall also state the all the design criteria. The geotechnical information shall be in the form of a report, complete with sketch providing all information required by the structural engineer. The geotechnical report and foundation design drawings shall be sealed by Engineers registered by the EGBC. Geotechnical and Structural will require both Schedule B1 and B2 forms filled out and signed in accordance with the BC Building Code. The design shall be in accordance with ministry standards.
- .7 Each custom sign structure must have a unique 5-digit number and name. This unique number and name shall be:
 - .1 Obtained from the Bridge Area Manager.
 - .2 Included with design drawings and tender documentation.
 - .3 Fabricated from aluminum plate 600mm by 200mm in size. Refer to I-064-3 sign record for details.
 - .4 Installed on the pole on downstream side approximately 1.5m above grade.
 - .5 The sign manufacturer will require the sign record in .PDF and .ai format. These files can be downloaded from:
<https://www2.gov.bc.ca/assets/download/6C41CD73C9784A9AB544C499FA13EEA4>
- .8 Sign structures are typically supplied by the Contractor as a lump sum for each structure. All technical data required for ministry pre-purchase must be included in the tender design. Refer to *Generic*

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Signing Special Provisions in Appendix 800 for clauses related to the structures.

505.4 SINGLE POST SIGN STRUCTURES

- .1 Single post sign structures are generally used to mount signs 1.2 m wide x 1.2 m high or smaller in shoulder applications. Where a sign is under 0.75 m wide x 0.9 m high, designers shall locate the sign on the nearest luminaire pole if the location does not compromise the location and visibility of the sign.
- .2 Standard types of single post sign structures and their application are as follows:
 - .1 Wood post structures are used in gravel shoulders. Wood posts are not recommended for use in asphalt or concrete islands, medians or sidewalks because they are difficult to replace. Refer to drawings SP635-3.5.1 to SP635-3.5.9 *Wood Post Sign Structure Installation Details* in the ministry *Standard Specifications for Highway Construction*.
 - .2 Perforated square steel post structures are generally used in shoulder applications and in asphalt or concrete islands, medians or sidewalks. Refer to drawings SP635-3.6.1 to SP635-3.6.4 *Perforated Post Sign Structure Installation Details* in the ministry *Standard Specifications for Highway Construction*.
 - .3 Round steel post structures are used in urban commercial areas and are generally mounted in concrete sidewalks, medians and islands. Many Municipalities commonly use these structures because they have a better appearance than the perforated square steel structures. In addition, the sign may be aimed because of the round pipe. Refer to the Round Steel Post Structure Installation Drawings in Section 635, Part D of the ministry *Standard Specifications for Highway Construction Drawings*.
 - .4 Round Steel Post Barrier Stand Structures are used to mount signs on concrete median or roadside barriers. Refer to the Round Steel Post Structure Installation Drawings in Section 635, Part D of the ministry *Standard Specifications for Highway Construction*.
- .3 Designers shall confirm the preferred type of structure typically used in the Highway District (e.g., wood post, perforated steel, or round steel) with the ministry District Transportation Manager.
- .4 To determine the capacity of the structure and the size of post (where variable), designers shall use sign loading tables in Appendix 500.

SIGN SUPPORT STRUCTURES

- .5 To calculate the size of post (where variable), designers shall confirm the:
 - .1 Sign area and the height from the center of the sign to the ground.
 - .2 Wind pressure. Use 1 in 10 year wind pressure return period for the area noted on the Wind Pressure Tables in Appendix 500.
- .6 Signs are made of sheet aluminum and in some special cases may be constructed of plywood.

505.5 MULTI-POST SIGN STRUCTURES

- .1 Signs that are over 1.2 m wide x 1.2 m high generally require a multi-post sign structure.
- .2 The standard types of multi-post, steel breakaway sign structures and their applications are as follows:
 - .1 Perforated Square Steel Sign Structures:
 - .6 Are used to mount small signs on highway shoulders and raised medians and islands (generally signs up to 2.44 m (W) x 1.22 m (H)).
 - .7 Are very light duty and will yield upon impact.
 - .8 Have limited loading capabilities.
 - .9 Are detailed on drawings SP635-3.6.1 to SP635-3.6.4 *Perforated Square Steel Sign Post Structures* in the ministry *Standard Specifications for Highway Construction*.
 - .2 Wood Post Sign Structures:
 - .10 Are more economical than breakaway sign structures, however, they do not have the equivalent loading capabilities.
 - .11 Are generally used to mount signs up to 3660 mm wide.
 - .12 Are detailed on drawings SP635-3.5.1 to SP635-3.5.9 *Wood Sign Post Structures* in the ministry *Standard Specifications for Highway Construction*.
 - .3 Steel Breakaway Sign Structures:
 - .13 Utilize slip base connection so that a leg will release and hinge upward when impacted and are generally used for mounting large signs on freeways and expressways.
 - .14 Are relatively expensive and should generally be used for signs that are at least 3660 mm.
 - .15 Are designed to be impacted at bumper height, typically 500 mm above the ground. Therefore, they should not be used near ditches, on steep slopes or at similar locations where a vehicle is likely to be partially airborne at the time of impact.

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- .16 Are detailed on drawings SP635-3.4.1 to SP635-3.4.12 *Breakaway Sign Structures* in the ministry *Standard Specifications for Highway Construction*.
- .3 To determine the capacity of the structure and the number of legs required, designers shall use the sign loading tables located in Appendix 500.
- .4 To calculate the number of legs, designers shall confirm the:
 - .1 Sign area and the height from center of the sign to the top of the concrete or ground at the longest leg.
 - .2 Wind pressure (use 1 in 10 year wind pressure return period). Refer to Wind Pressure Tables in Appendix 500.
- .5 Two or three leg structures may be used for breakaway and wood post structures provided minimum leg spacing distances are maintained. Only 2 leg structures shall be used with perforated square steel tubing unless otherwise directed.
- .6 Shoulder mounted sign structures are generally not illuminated.
- .7 Detailed elevations are required for each multi - post sign structure. These elevations shall be included on the signing and marking drawings. Refer to details in Appendix 700.1.
- .8 Sign mounting hardware is generally supplied by the contractor therefore the design shall detail the required leg lengths on the structure elevations. In cases where the ground is sloped, this may involve a field survey to verify existing grades and slopes.

505.6 SIGN MOUNTING ON OVER/UNDERPASSES

- .1 Where practical, large directional guide signs may be mounted on overpass or underpass structures. Mounting signs on an over/underpass structure is generally more economical than installing a sign bridge or cantilever structure.
- .2 The feasibility of mounting signs on overpass and underpass structures should be determined by a structural engineer who in turn shall consult with the Regional Bridge Engineer.
- .3 The contractor shall generally supply the sign mounting hardware. Designers are required to provide the following details on the Contract Drawings:
 - .1 These drawings shall be designed, signed and sealed by a structural engineer registered with the EGBC. Drawings shall contain specification and design criteria in accordance with ministry Bridge Engineering standards and general practice.
 - .2 Schedule B1 and B2 in accordance with the BC Building Code.

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- .4 The sign mounting brackets shall be fabricated in accordance with ministry *Electrical & Signing Material Standards, Chapter 306 - Cantilever and Sign Bridge Structures*.
- .5 Generic sign mounting drawings have been developed. These drawings will require modification to suit the specific installation. Generic drawings can be found in Appendix 700.1.