BRITISH COLUMBIA

Section 500

Electrical and Sign Support Structures

Engineering Branch

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500 ELECTRICAL AND SIGN SUPPORT STRUCTURES

LIST OF TABLES

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501 INTRODUCTION TO ELECTRICAL AND SIGN SUPPORT STRUCTURES

501.1 ABOUT SECTION 500

Section 500 provides the guidelines for the design of electrical and sign support structures within the British Columbia Transportation System. This section covers items, which are common to signal, lighting and signing installations. In addition, traffic counter stations are covered in this section.

Items specific to lighting, such as lighting levels, luminaires, types of lighting systems and applications are covered in *Section 300*.

Items specific to signals 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 YOU BEGIN

.1 Designers shall use 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 Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction* for a table listing all standard Ministry bases and the structures that may be installed on them. .

.3 When specifying Type D, E, F, S, L, M or H concrete bases, designers shall confirm the cross-section of the existing or proposed site conditions and select the most cost-effective base for the site conditions. General guidelines as noted on the Luminaire Pole Base Installation & Backfill Requirements Drawings in Section 635, Part B, 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 constructable 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, Part B, of the Ministry *Standard Specifications for Highway Construction.* If soils an alternate custom base design may be required.

.7 Sign bridge and cantilever 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 sign bridge and cantilever 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.

502.2 JUNCTION BOXES AND VAULTS

.1 Junction boxes are used to make wiring connections at each pole or each split in the conduit system. Generally, junction boxes are not spaced more than 100 metres apart.

.2 Where possible, position junction boxes to avoid being driven over by vehicles or walked over by pedestrians. Junction boxes shall not be located in wheelchair ramps. When locating junction boxes access to the boxes shall be a strong consideration. For this reason locating boxes in paved areas should be avoided as costly lane closures would be required to access the boxes. 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.

.3 Junction boxes shall be positioned on the downstream side of poles.

.4 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.

.5 The Ministry 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)
- .3 Small round plastic junction boxes (Type 14)
- .4 Concrete junction box
- .5 Small concrete vault

.6 Large round plastic junction boxes are the most common type of junction box used by the Ministry. Types 10 to 13 large round plastic junction boxes are described as follows:

.1 Type 10 is comprised of two sections, steel lid and plastic drain plate in accordance with Type 10 Junction Box Installation Drawings in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. 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, steel lid and plastic drain plate in accordance with Type 11 Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. 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, steel lid and plastic drain plate in accordance with the Type 12 Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. 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, Part B of the Ministry *Standard Specifications for Highway Construction*. 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.

.7 With the exception of Type 8 and 9 boxes, rectangular plastic junction boxes are an older standard and are generally not used for new installations. However, their rectangular shape can be an advantage over large round plastic junction boxes where space is limited. Types 6 to 9 rectangular plastic junction boxes are described as follows:

.1 Type 6 is comprised of two sections, steel lid, drain plate and mid brace in accordance with the Type 6 Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. This box is generally used in all applications except where listed below under *Paragraphs 502.2.7.2* to *502.2.7.5*.

.2 Type 6 Special is comprised of two plastic sections, steel lid, concrete collar, plastic drain plate and mid brace in accordance with the Type 6 Special Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. This box is used in most paved areas subject to wheel loading.

.3 Type 7 is comprised of three plastic sections, steel lid, plastic drain plate and mid brace in accordance with the Type 7 Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. This box is used in most curb areas. The height of the third section is cut to suit finished grade and allows conduits to be buried to their required depth.

.4 Type 8 is comprised of three plastic sections, steel lid, concrete collar, plastic drain plate, and mid brace in accordance with the Type 8 Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. This box can be used in all narrow medians or islands with island or median curbs where it is not possible to fit a Type 12 large round plastic junction box. The main advantage of this box over a Type 7 is the main box can be installed in advance of paving and curb installation. The top section is then cut to fit after curbs are installed.

.5 Type 9 is comprised of one plastic section and one steel lid in accordance with the Type 9 Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. This box is can be used to feed post mounted flasher luminaires at the ends of islands or medians with island or median curbs where teck is run on top of the pavement (teck cable is required to compensate for insufficient cover over the conduit). Refer to *Paragraph 502.2.9* for an explanation of curb types. The junction box section is cut to sit on the pavement surface within the islands or median. The junction box is then surrounded with concrete.

.8 Small round plastic junction boxes are used for short duration traffic counter stations or special applications. Type 14 small round plastic junction boxes are described as follows:

.1 Type 14 is comprised of two plastic sections, steel lid and plastic drain plate in accordance with the Type 14 Junction Box Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. 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.

.9 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.

.10 The maximum number of conduits entering a Type 9, 13, or 14 junction box should not exceed 2-2″ R.PVC and the required 1″ R.PVC detector loop conduits.

.11 The maximum number of conduits entering a large round or rectangular plastic junction box shall not exceed ten. Where more than 10 conduits enter a box see *Sub-clauses 502.2.12* and *502.2.2.13* below.

.12 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, Part B of the Ministry *Standard Specifications for Highway Construction.*

.13 Small concrete vaults can be used where more than twenty conduits enter a box. Concrete vaults are as detailed on the Small Concrete Vault Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*. 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.

.14 Special concrete communication vaults may be required for communications conduit systems. Distances between vaults shall be a based on pulling friction, type of cable and conduit size, method of cable installation (i.e., cable jetting). When determining the type of vault and distance between vaults, the designer shall research and reference proven industry standards for communication systems.

.15 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.

.16 All junction boxes shall be specified with steel lids. Plastic junction box lids may be considered in areas behind barrier or sidewalks.

.17 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 R. PVC 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 H-10 load rated covers with tread plate.

502.3 CONDUITS

.1 Buried conduits are generally 2-inch R. PVC, except in the following applications:

.1 In areas where conduit fill exceeds the capacity of a 2-inch conduit, 3-inch conduit may be used.

.2 Communications conduits shall be a minimum of 2-inch. Designers shall confirm the size, type and number of communications conduits required with the Ministry Electrical Representative.

.3 Detector loop lead conduits shall be 1-inch R.PVC as noted on Loop Conduit Installation Drawings in Section 635, Part B 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 1-inch R. PVC as noted on Post Mounted Flasher Concrete Base Installation Drawing in Section 635, Part B of the Ministry *Standard Specifications for Highway Construction*.

.2 Three 2-inch R. PVC 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, predicting 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. 3-inch R. PVC 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 via a suitable trenchless technology to avoid cutting the existing paved surface. The designer shall define *"Trenchless Technology"* as opposed to defining a specific method (i.e., drilling, augering, 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 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 2" R.PVC conduit installed in a 3" casing pipe and pushed or drilled under the tracks at a depth of 1200 mm. For further direction on railway crossing permits contact the Rail & Navigable Waters Coordinator, Engineering Branch, Victoria. Refer to generic DS Series detail in Appendix 700.1

.6 The Ministry requires that conduit generally be cast into most new bridge structures in areas anticipated to have future electrical infrastruture. 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 Ministry Electrical Representative and confirm conduit size and routing with the Bridge Design Engineer. Refer to generic DS Series detail in Appendix 700.1

.7 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.

.8 Conduits may be surfaced mounted as follows:

.1 Rigid Metal Conduit (RMC) should be considered for most surface mounting applications where the conduit diameter does not exceed 2″.

.2 Flexible Metallic Conduit (FMC) should be considered for surface mount applications where minor bends are required.

.3 R.PVC 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 R.PVC may produce toxic fumes.

.4 FRE Conduit should be considered as an alternative to RMC and FMC for 2″ and larger diameters.

503 CLEAR ZONE

503.1 GENERAL

.1 Clear zone is defined as the roadside border area adjacent to the roadway clear of fixed objects, which may be traversed by errant vehicles. The width of the clear zone is dependent upon the traffic speed, traffic volumes and road geometry and alignment.

.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 Structure

.6 Delineators

.7 Short Duration Counter Stations

.8 Luminaire and sign poles with breakaway type bases

.9 Signal poles

.3 All structures listed under *Paragraphs 503.1.2.1* to *.8* are designed to breakaway upon impact. The designer shall ever make very attempt to locate these devices outside the clear zone

503.2 REQUIREMENTS

.1 Clear Zones shall be calculated by using *Table 1* below. The clearance distances shown were taken form Table 1 from *Technical Bulletin DS96001*. See *Section 100* for information on *Technical Bulletins.*

Design AADT	Minimum Clear Zone Width				
	Design Speed (km/h)				
	60 or less	70 to 80	90	100	110 to 120
Under 750	1.8m	3m	4m	5m	6m
750-1500	3m	4m	5m	6m	7m
1501-600	4m	5m	6m	8m	9m
Over 6000	5m	6m	7m	9m	11m

Table 1. Clear Zone

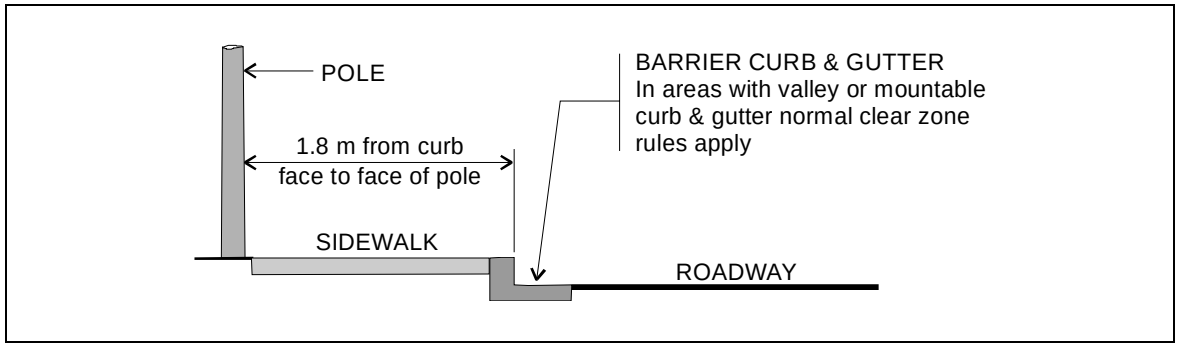


Figure 1. Clear zone in areas with barrier curb and gutter and posted speed of 60 km/h or less

.2 Designers shall locate poles and structures outside the clear zone where practical. Additional fill around the pole bases may be required. If it is not practical to locate poles and structures outside the clear zone, the designer shall consider:

.1 Using a frangible or breakaway base as described in *Clause 504.3.* These devices only apply to Type 1, 2 and 3 shafts (not required for signal poles).

.2 Protecting the pole or structure with barrier or impact alternatives, however, both barriers and impact alternatives are obstructions. If possible locate the pole outside the clear zone.

.3 For electrical or signing designs that are part of a roadworks 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 roadworks designer. The protection shall form part of the roadworks design. Where a project has no roadworks 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 Electrical Representative.

.4 Traffic controllers shall be located outside the clear zone.

.5 Avoid locating luminaire and sign poles in narrow medians.

.6 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.

.7 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 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.

.2 Standard luminaire poles are detailed on the applicable Pole Installation Drawings in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. For manufacturing details, refer to the Ministry *Electrical and Signing Material Standards Manual*, Section 301- Traffic Signal, Luminaire and Sign Pole Structures.

.3 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 applicable Pole Installation Drawings in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. However, signs shall not be mounted on poles with service panels and/or traffic controllers.

.4 For information on mounting equipment such as banners and receptacles refer to *Apprendix 500.3* and *Appendix 500.4*

.5 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 mmϕ must be reinforced with a bushing as shown on the Service Panel Bushing Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. This shall apply when installing a service panel, which requires a 60 mm diameter hole for wireway entry into the pole. Refer to *Sub-Clause 504.4.11* for more information.

504.2 SIGNAL POLES

.1 Standard signal poles are detailed on the applicable Drawings in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. For manufacturing details refer to the Ministry *Electrical and Signing Material Standards Manual*, Section 301 - Traffic Signal, Luminaire and Sign Pole Structures.

.2 Adding Load to existing traffic signal poles:

.1 Loading on existing traffic signal poles only shall not have a combined stress ratio over 1.25.

.2 Loading on existing traffic signal poles shall not be overloaded more than 25 percent (i.e., combined stress ratio not exceeding 1.25).

.3 Pole loading shall be verified by the Ministry's Pole Capacity Program

.3 Ministry standard signal poles and shafts and their usages are as follows:

.1 Type 4 Shafts are 2.5 m high and shall be used for mounting single signal heads.

.2 Type 4A Shafts are 4.0 m high and shall be used where secondary and pedestrian signals cannot be mounted on a signal pole because of visibility problems. Up to 4 signal heads can be mounted on this pole.

.3 Type 5 Shafts are 5.0 m high and shall be used for mounting double left turn lane signal heads in traffic medians. They can also be used for mounting single primary heads at 'T' intersections.

.4 Type 1 and 3 signal poles may be used for traffic signals in rural areas, depending on the span and the wind pressures. Primary signal heads, small signs, pedestrian and secondary heads and pedestrian pushbuttons may be mounted on these poles. A Type 1 pole is a combination luminaire/signal pole and a Type 3 is a signal pole only. In urban areas, Type 1 and 3 signal poles may also be used on minor one lane cross-streets where future road widening is not anticipated.

.5 Type 6 and 7 signal poles are non-current Ministry Standard and are generally replaced with Type S poles.

.6 Type S, L and M signal poles are used for traffic signals in urban and rural areas where Type 1 or 3 poles can not accommodate the loading. Primary signal heads, small signs, pedestrian and secondary heads and pedestrian pushbuttons may be mounted on these poles.

.4 To reduce driving obstructions, poles shall be placed away from the roadway. Always attempt to place poles behind sidewalks (Refer to *Clause 503* when placing signal poles). Signal poles should be no less than 1m from face of curb.

.5 Generally, signal pole davits shall be oriented at 90 degrees to the centreline 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 2* to avoid signal head visibility conflicts. Using various combinations of standard signal pole equipment, pole arms can reach from 3 m to 17 m.

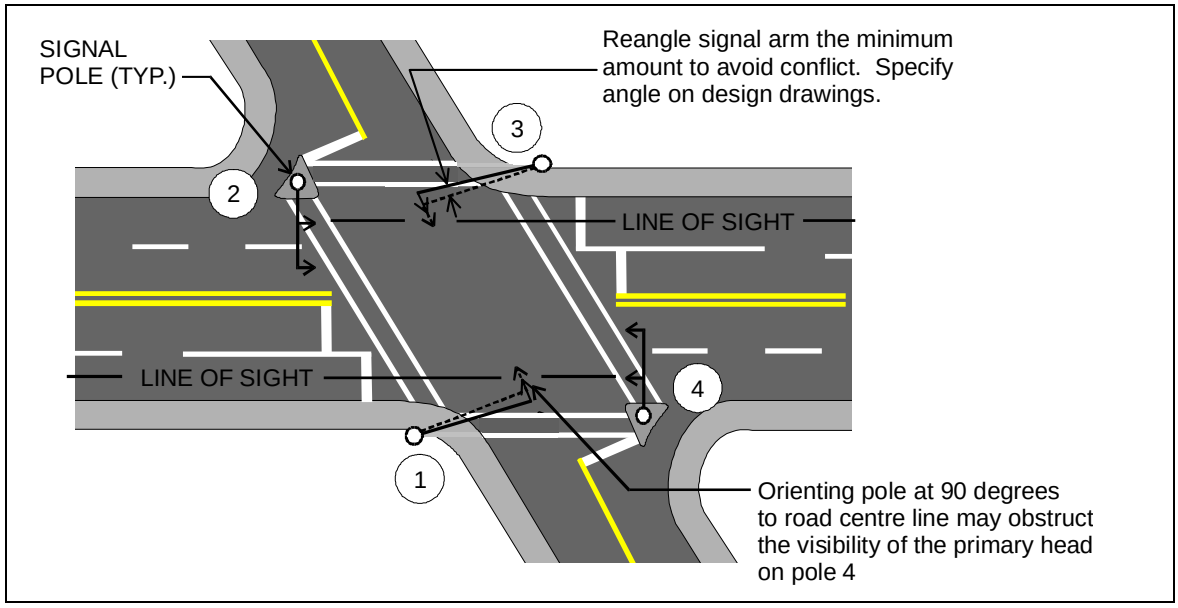


Figure 2. Signal arm orientation at skewed intersections

.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 centre 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 4 or 4A poles must be used to improve the visibility of secondary and pedestrian signal heads and to reduce walking distance to pedestrian pushbuttons. Typically, additional 4 or 4A poles are required at skewed intersections and at intersections with large radius corners and no traffic islands.

.9 Where pole loading requires calculation, designers shall use the most current version of the Ministry's Pole Loading Program to confirm the pole can support the required loading. The Pole Loading Program is an Excel spreadsheet allowing designers to determine the type of pole required by entering the signal head type, sign area, span and the wind pressure for that area. A copy of the Wind Pressure Tables and Pole Capacity Program may be found in *Appendix 500*. It is the responsibility of the designer to ensure they have the latest version of the Pole Capacity Program.

.10 Avoid mounting more than 4 heads on a pole shaft.

.11 Use the formula in *Figure 3* to calculate the signal arm lengths for Type L, M or S poles.

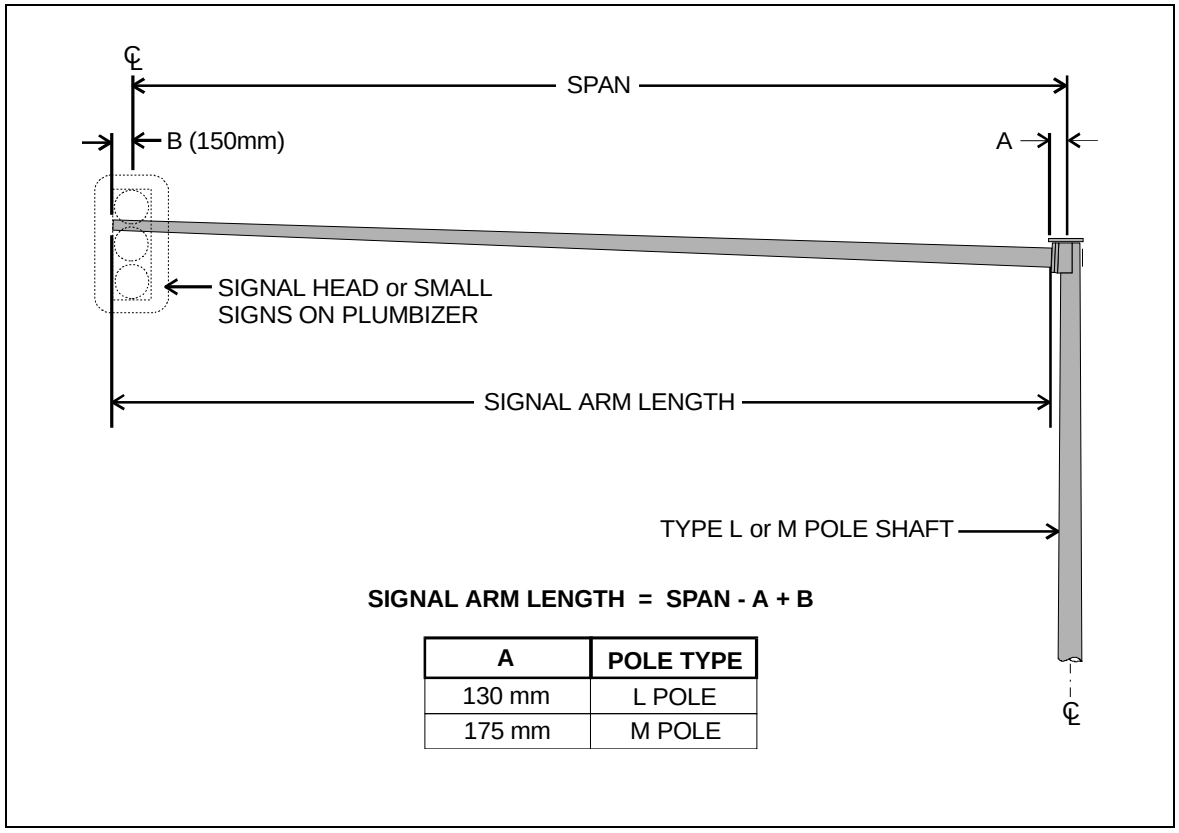


Figure 3. Method of calculating signal arm lengths for Type L, M and S poles

.12 Where field drilled holes larger than 32 mmϕ are required in Type 1, 3, 6, 7, L and M signal poles, they shall be supplied with a reinforced bushing as shown on the Service Panel Bushing Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. This shall apply where installing a 100 A service panel, which requires a 60 mmϕ diameter hole for the wireway entry into the pole. The designer shall note that 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 and/or traffic controllers on signal poles should be avoided where possible.

.13 Streetname signs are generally bolted onto signal pole arms. Designers shall locate the signs as noted in *Figure 4*. 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.

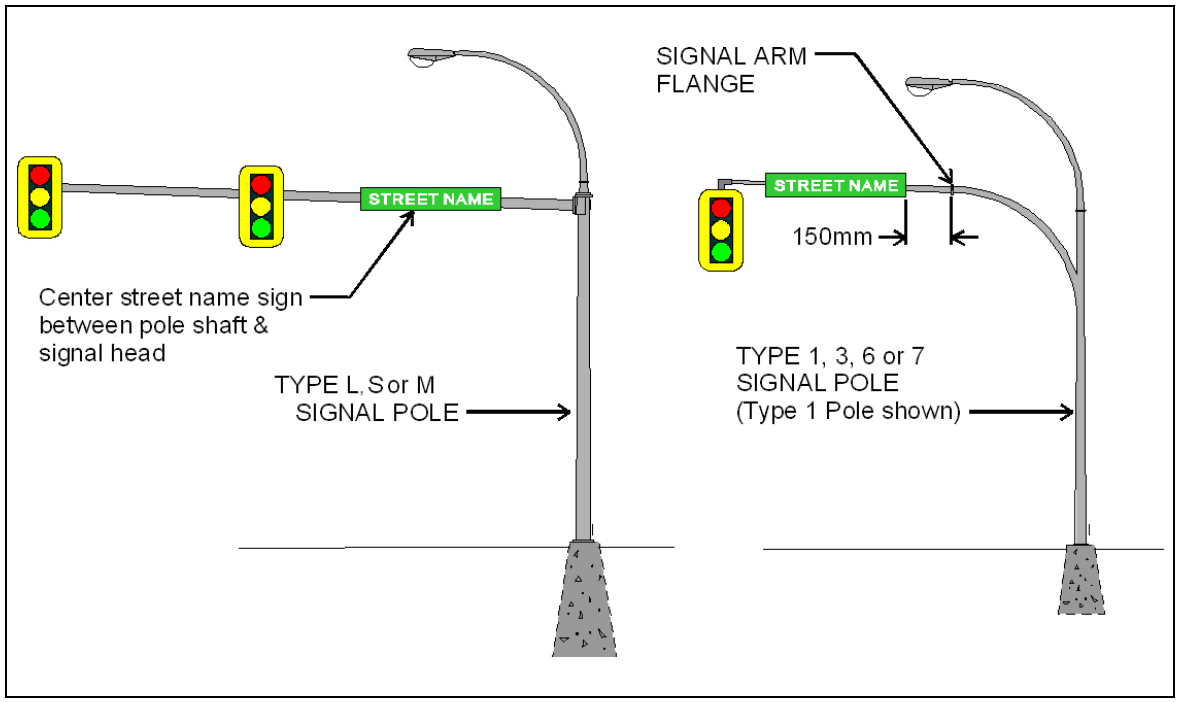


Figure 4. Positioning streetname signs

.14 Small traffic signs may be required on signal pole arms. Where required they shall be detailed along with the type of mounting bracket on the signal pole elevation. Use a spring cushion mid or end mount sign hanger for Type 1, 3, 6 and 7 poles and a plumbizer sign mount bracket for Type L, M and S poles. Refer to Small Sign Mounting Drawings in Section 635, Part D of 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 verify luminaire arms are not in conflict with overhead power line. Where conflict can be avoided, as last resort the designer shall consider a custom luminaire arm. Refer to the generic DS Series drawing in Appendix 700.1 for an example of a custom arm aimed at mitigating conflicts.

504.3 FRANGIBLE AND BREAKAWAY BASES

.1 Frangible and breakaway bases are safety devices installed between the pole base plate and the concrete base, allowing the pole to breakaway when impacted by a vehicle. When using a frangible or breakaway base, poles may be located within the clear zone. Refer to *Chapter 503* for more information on the clear zone.

.2 Frangible bases are designed to accommodate Type 2-6.5m and 8.5m shafts. Breakaway bases are designed to accommodate Type 2-11m and Type 1 and 3 shafts. This includes advance warning signs and guide signs on Type 1 and 3 poles with signs not exceeding approximately 2.44 m (W) x 1.22 m (H) with a span from the pole shaft to the centre of the sign not exceeding 3.1 m.

.3 Frangible and breakaway bases should not be installed in the following scenarios:

.1 At intersections with raised medians or islands or crosswalks.

.2 Generally behind sidewalks, except in areas with a posted speed of 70 km/hr or over, where located within the clear zone (Note - In areas 70 km/h or over, the clear zone is the same for curb and gutter and open shoulder areas).

.3 Behind concrete barriers.

.4 On retaining walls or bridge structures.

.4 Frangible bases shall not be installed on signal poles or sign poles.

.5 Frangible bases are used on 7.5 m, 9.0 m, and 11.0 m luminaire poles. Breakaway bases are used on 13.5 m luminaire poles only. Frangible and breakaway bases for luminaire poles are detailed on the Frangible & Breakaway Sign Base Drawings in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*.

.6 Breakaway bases are currently used on Type 1 and 3 sign poles. The breakaway base used for Type 1 and 3 sign poles is detailed on the Breakaway Base Drawing in Section 635, Part D of the Ministry *Standard Specifications for Highway Construction.*

.7 Luminaire poles and shafts with service equipment which are located within the clear zone shall have frangible or breakaway bases. The designer shall, however, make every attempt to locate services outside the clear zone.

504.4 SERVICES

.1 Standard Ministry services are as follows:

.1 100A (120/240V) overhead drop services

.2 100A (120/208V) overhead drop services

.3 100A (120/240V) underground dip services

.4 100A (120/208V) underground dip services

.5 30A (120/240V) overhead drop services

.6 Telephone overhead drop services

.7 Telephone underground dip services

.2 Standard services are as detailed on the applicable Drawings in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*.

.3 Standard services are described as follows:

.1 120/240V 100A panels have a 100A - 2 pole main breaker and space for up to 16 circuit breakers, 3 contactors and 1 flasher control unit.

.2 120/208V 100A panels have a 100A - 3 pole main breaker and space for up to 24 circuit breakers, 3 contactors, and 1 flasher control unit.

.3 120/240V - 30A panels have a 30A - 2 pole main breaker and space for up to 6 circuit breakers, 1 flasher control unit and one contactor.

.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 (60A double pole breaker is no longer used for controller due to the exclusive use of LED signal heads by the Ministry)

.3 15A single pole breaker for PEC and flasher unit

.5 Lighting contactors are size 1 - 4 pole type (30A).

.6 30A service panels are primarily used for isolated installations of 2 or 3 luminaires, overhead illuminated signs, flashing beacons and special crosswalks.

.7 120/240V single phase is normally used because it is readily available from utility companies. Designers shall consider 120/208V, three phase for services with large loads and long branch circuit runs. When considering

120/240V or 120/208V, designers shall take into account any utility company costs for supplying 120/208V versus wiring cost savings associated with a 120/208V service. In all cases, designers shall select the most cost-effective service voltage.

.8 All service locations shall be confirmed in writing by the utility company.

.9 The majority of Ministry services are not metered. Metered services are required for special applications where flat rate billing has not been established. These services typically include tunnels, lighting with multi-level controls, motors, fans, buildings, etc.

.10 100A service panels may be installed on all Type 2 (excluding installations with 2C arms), 4, 4A and Type 5 shafts. All other shafts requiring a service panel must be supplied with a bushing to reinforce the hole into the pole. The service panel bushing is detailed on Service Panel Bushing Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. The bushing height will vary for an underground or overhead service. Where possible, avoid installing 100A service panels on sign poles.

.11 Where possible, designers shall avoid locating services on signal poles with pushbuttons, poles in traffic islands and poles with frangible bases. Instead, designers shall consider locating the service on a separate post outside the highway 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 SP635-2.4.16
- .3 Maintenance pad – ensure concrete maintenance pad can be constructed level and will not slump off down a slope. (Refer to SP635 drawings)
- .4 Ease of access for maintenance - where possible try to locate at the same corner as the traffic controller.
- .5 Obstruction to public.
- .6 Safety of maintenance staff and the public.

.13 The majority of services are overhead type. Underground dip 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 the Ministry Electrical Representative.

.14 All services shall be grounded with a ground plate as detailed on the Ground Plate Installation Detail Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*.

.15 Telephone services are required where specifically request by the Regional Traffic Engineer. They should be installed, where possible on the same pole as the electrical service panel for the signal. Where the telephone service is not being installed or required in the near future as a minimum the underground conduit for the telephone service should be installed.

.16 347/600V services may be permitted for specialized electrical installations where the loads are too large to economically accommodate 120V services.

These specialized installations may include large tunnels, large lighting systems, swing bridges, and highmast lighting systems. Under no circumstances will 347/600V be permitted for conventional roadway lighting where poles are subject to knockdown. The use of 347/600V must be approved by the Ministry Electrical Representative.

.17 Where 347/600V services are used the following is required:

.1 Provide aluminum plates with black engraved letters indicating "347/600V" on all pole handhole 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.

.3 Circuits shall be bundled and tagged with lamacoid labels indicating the circuit numbers.

.4 Review the requirements for additional tagging and labeling with the Ministry Electrical Representative and the Manager, Electrical Services.

504.5 WIRING

.1 Ministry electrical systems are generally wired with RW90 (XLPE) stranded copper conductors. Wiring runs through an underground conduit system.

.2 Signals shall use signal cable for the signal conductors if directed to do so by the Manager, Electrical Services or the Ministry Electrical Representative. Signal cable shall run for the controller to a pole or poles at given corner of the intersection.

.3 Signal cable is detailed on Signal Cable Wiring and Colour Coding Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. All signal conductor splices shall be made in the pole handholes.

.4 All wiring shall conform to all Canadian Electrical Code requirements.

.5 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.

.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. Refer to generic DS Series drawings in Appendix 700 for details.

.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.

.6 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. The bond conductor potential rise at the furthest end of the circuit shall not exceed 50V.

.7 All single conductor wiring shall be supplied in the colours noted in Signal Cable Wiring and Colour Coding Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction.*

.8 All wiring circuits shall be protected with circuit breakers which are located in the service panel. In addition, luminaire circuits are protected with a 10A in-line fuse located in the pole handhole as noted on Luminaire Wiring in Pole Handhole Drawing in Section 635, Part C of 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.

.9 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.*

.10 Typical types of branch circuits fed from a service panel and preferred wire sizes are as follows:

.1 Luminaires - No 6 (AWG) to No 10 (AWG)

.2 Traffic controllers - No 10 (AWG)

.3 Island flashers - No 14 (AWG)

.4 Photocells- No 14 (AWG)

.5 Flashing beacons - No 14 (AWG)

.11 Where possible, designers shall arrange the service locations so the maximum wire size used is No 6 (AWG). If this is not possible, heavier gauge wires may be used provided it is cost effective.

.12 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 10 (AWG) for main conduit runs around intersection

.3 Advance warning flashers - No 14 (AWG)

.4 Fire indication lights - No 14 (AWG)

.13 Wire sizes listed under *Paragraphs 504.5.10* and *504.5.12* may vary depending on load and voltage drop. Designers are responsible for ensuring the load and voltage drop are within the allowable values.

.14 Typical 120/240V luminaire branch circuit wiring is as shown in *Figure 5*.

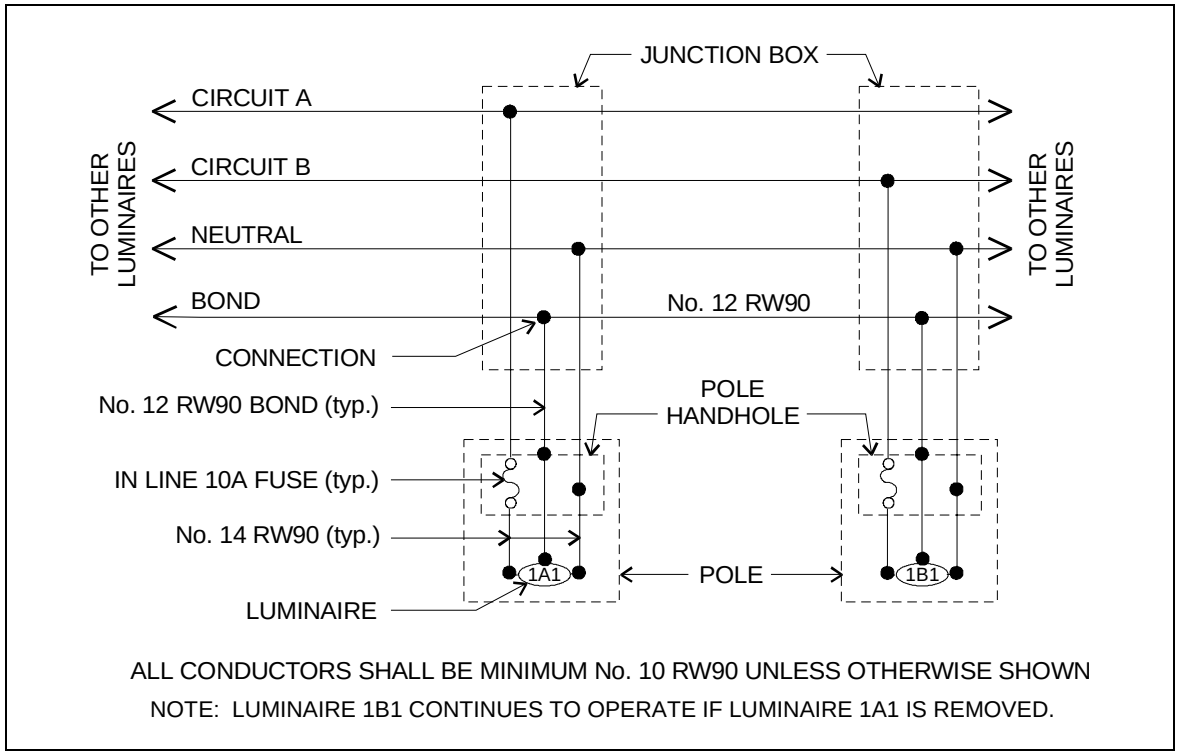


Figure 5. Typical 120/240V luminaire branch circuit wiring

.15 If the service will not be expanded beyond two lights, lighting circuits may be wired through the photocell without the use of a contactor. The wiring is similar to that shown on *Figure 5* except that circuit B is removed. A contactor is not required.

.16 Typical 120V traffic signal branch circuit wiring is as shown in *Figure 6*. For signal cable no conductor splices will be allowed in the junction boxes.

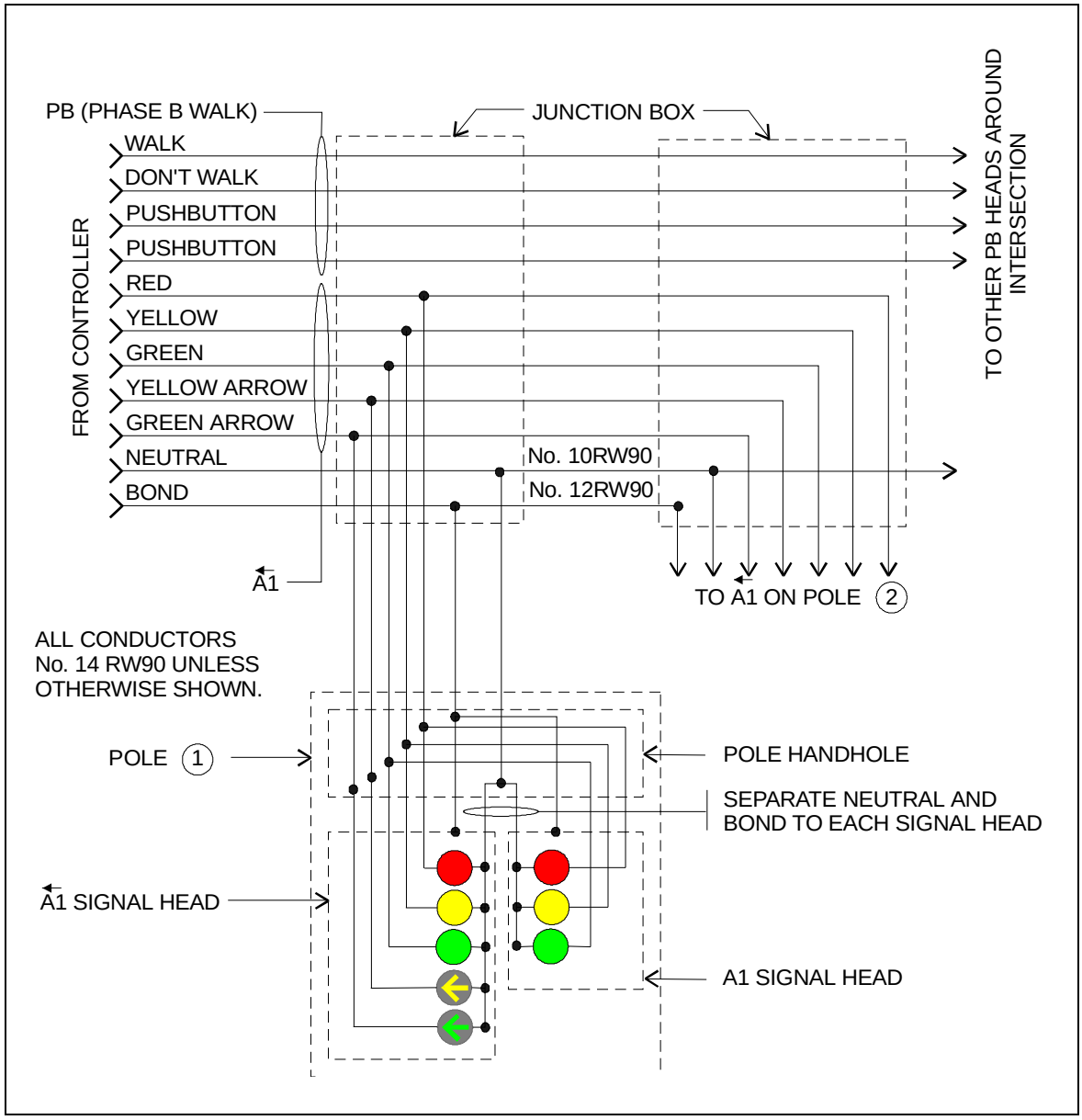


Figure 6. Typical 120V traffic signal circuit wiring (for single conductor)

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 the Ministry Electrical Representative.

.2 All other circuits, including traffic controllers, post-mounted flasher luminaires, etc., shall not exceed 3 percent.

.3 Where an underground dip 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 2*. The D-C resistance of 25° C represents a realistic temperature value for conductors buried in earth. Designers shall note that Rac/Rdc=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^{O}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
* Rac/Rdc Ratio = 1 for #14 to 2/0 wire in non-metallic conduit.			

Table 2. 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 3* below.

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 COUNTER STATIONS

.1 Traffic counter stations are used to obtain vehicle count data. The stations consist of detector loops cut into the roadway and connected to traffic counter devices. Refer to *Section 400* for more information on detector loops.

.2 There are two types of traffic counter stations:

.1 Short duration traffic counter stations are required for part time data collection only. They consist of detector loops cut in the roadway with the loop wires run in one or more conduits from the edge of the asphalt to a perforated square steel post located on the road shoulder as detailed on Short Duration Traffic Counter Station Installation Drawing in Section 635, part C of the Ministry *Standard Specifications for Highway Construction*. A short duration traffic counter station can feed up to 6 detector loops.

.2 Permanent traffic counter stations are required for full-time data collection. They consist of detector loops cut into the roadway with the loop home run wire installed in a conduit from the edge of the asphalt to a junction box and shielded cable and conduit to a pole mount cabinet unless other wise noted. A telephone service will also be required at each permanent Traffic Counter Station. Refer to Permanent Traffic Counter Installation Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*.

504.8 POST MOUNTED FLASHERS

.1 Post mounted flasher luminaires are generally used as supplements to Keep Right/Left Signs (R-14R/L) and Hazard Signs (W-54L/R/D), and are not used as stand-alone devices. The flasher luminaires are an auxiliary device used to accentuate road obstruction warning signs, typically at the end of continuous sections of median barriers, raised median islands or other fixed objects. The use of island flashers shall be reviewed on a case by case basis with the Regional Traffic Engineer and the Ministry Electrical Representative.

.2 Post mounted flashers are not required in low speed zones (60 km/h or less), or in illuminated areas when an object marker sign is used. A post-mounted flasher may be used in low speed zones when a particular site has a documented accident history related to the road feature which the post-mounted flasher accentuates.

.3 Where posted speed is greater than 60 km/h or there is no roadway lighting Post Mounted Flashers shall be used in the following scenarios:

.1 In raised centre medians as detailed in the Ministry *Manual of Standard Traffic Signs and* Pavement *Markings*.

.2 At the approach ends of left turn channelization concrete median barriers. On 5.0 m high signal posts or Type 3 signal posts located in raised centre median for double left turn lanes. (Flasher luminaires shall not be installed on 2.5 m high signal posts located in raised centre medians for single left turn lanes).

.3 Other specialized applications warranting flasher luminaires shall be reviewed with the Regional Traffic Engineer.

.4 Where flasher luminaires are required at impact attenuators or crash barrels, the preferred flasher post and sign mounting locations are as shown in *Figure 7.*

.5 The Ministry does not install flashers on the municipal legs of an intersection.

.6 In locations where it is not cost-effective to supply power for flasher luminaire an object marker (sign) may be used with prismatic sheeting for a higher level of retro-reflectivity. This shall be reviewed with the Regional Traffic Engineer.

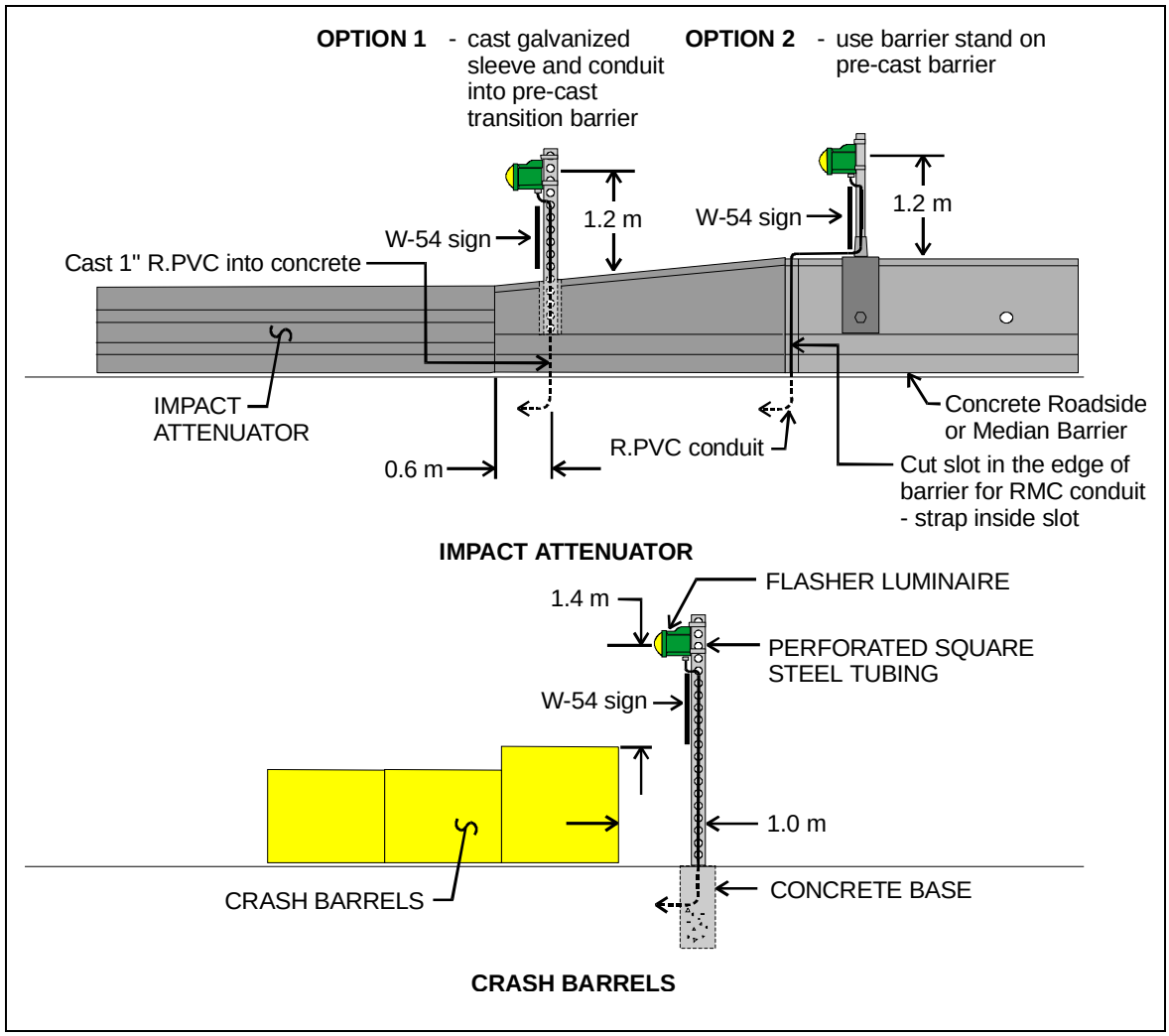


Figure 7. Flasher luminaire locations at impact attenuators or crash barrels

.7 Where future left turn signal posts are anticipated or the bases exist, the signs and flasher shall be mounted on the concrete base. The flasher and sign combination shall be mounted on a frangible base. Refer to generic DS Series drawing in Appendix 700.1

.8 Flasher luminaire installation details on perforated square steel tubing are detailed on the Flasher Luminaire Installation Drawings in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*. Flasher luminaires may also be installed on steel poles as detailed on the Flasher Luminaire Installation Drawings in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*.

.9 Flasher luminaires:

.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 minutes with an equal on and off period.

.3 Use incandescent traffic signal lamps.

.10 Flashers and signs must be shown, with the corresponding sign number, on the electrical drawings (e.g.: W-54L, R-54D, R-14R).

.11 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.

.12 Solar LED flashers are in the developmental stages and may be considered by the Ministry in site specific applications. Contact the Ministry Electrical Representative for more information.

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, sheet aluminum or plywood. New signs shall typically be aluminum. For a comprehensive listing of sign sizes and substrates, refer to the latest edition of the Ministry Traffic Signs Catalog or consult the Regional Traffic Engineer. In most cases, extruded aluminum signs are manufactured in standard widths, starting at 2440 mm and increasing in increments of 610 mm to 7320 mm. Heights are in intervals of 305 mm.

505.2 SIGN POLES

.1 Standard sign poles are detailed in the applicable Sign Pole and Sign Mounting Drawings in Section 635, Part D of 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 Manual*, Section 301 - Traffic Signal, Luminaire and Sign Poles.

.2 Ministry Standard Galvanized Steel Sign Poles are as follows:

.1 Type 1 and 3 sign poles may be used for signs up to 2.44 m wide x 1.22 m 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.

.2 Type S, L, M and H sign poles are the most commonly used poles for mounting overhead signs. No breakaway device exists for these poles.

.3 The Ministry has made a risk management decision to accept pole loading on Type 1 and 3 sign poles that do not extend over the traveled portion of the road (see *Figure 8*). Type and 3 signal poles shall not be overloaded more than 25 percent (i.e., combined stress ratio not exceeding 1.25). Type 1 and 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). Pole loading shall be verified with the Ministry Pole Capacity Program.

.4 Type 6 and 7 sign poles are an old Ministry standard and should no longer be used except for maintenance. The Type 6 and 7 poles have been replaced by the Type S poles. Type S poles have the same base plate as the Type 6 and 7 poles, however Type S poles look similar to Type L poles.

.5 Avoid locating poles within the clear zone. When locating poles in the highway clear zone:

.1 Type 6, 7, S, L, M and H poles must be protected by concrete roadside barriers or other approved means. Refer to *Clause 503.2* for more information on protection and clear zone.

.2 Type 1 and 3 poles may be mounted on a breakaway base, thus requiring no protection. For more information on Breakaway bases, refer to *Clause 504.3.*

.6 It is not permitted to locate sign poles in medians less than 1.3 m wide.

.7 Where field drilled holes larger than 32 mm in diameter are required in Type 1, 3, 6, 7, L, M, and H, the poles shall be reinforced with a bushing as shown on Bushing Installation Drawing in Section 635, Part C of the Ministry *Standard Specifications for Highway Construction*.

.8 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.

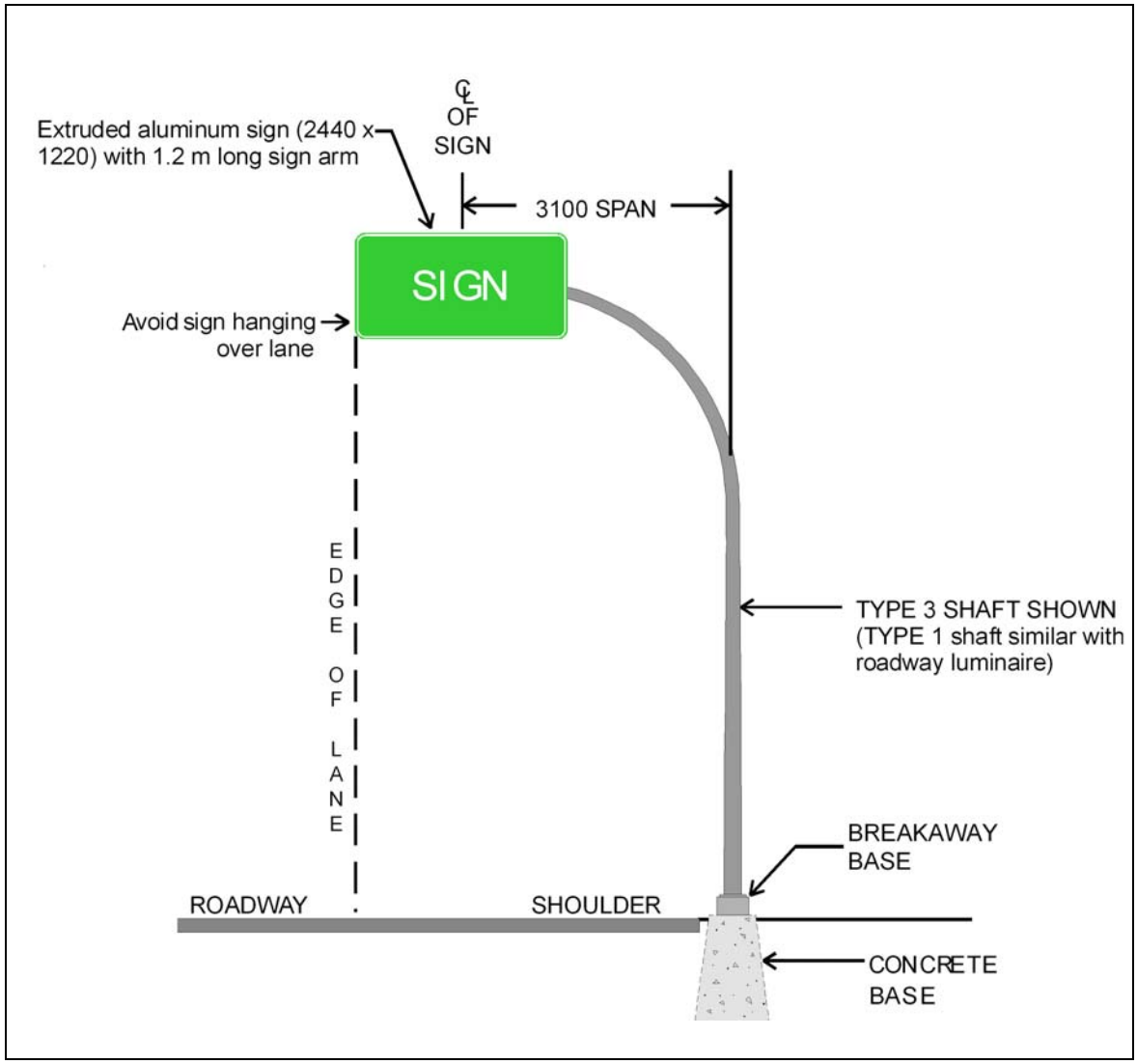
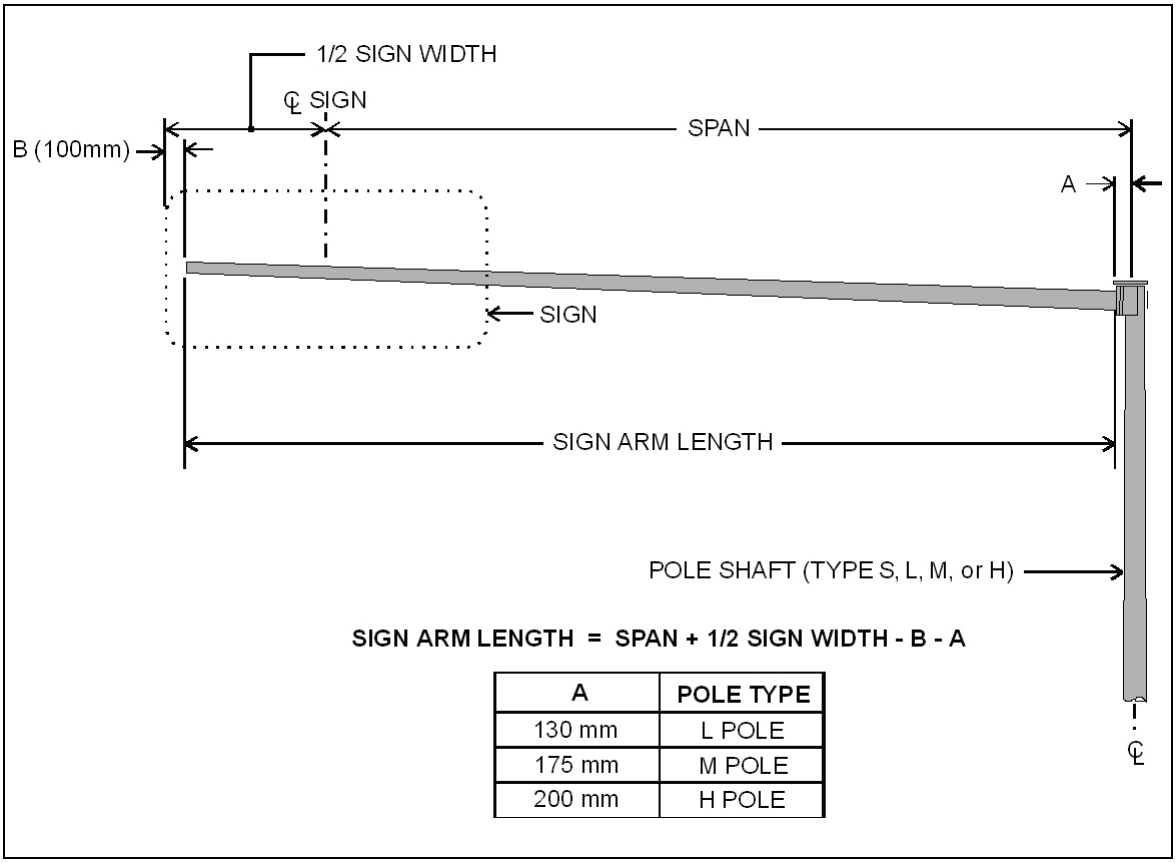


Figure 8. Type 1 or 3 sign pole

.9 Where pole loading is in question, designers shall use the most current version of the Ministry's Pole Loading Program to confirm the pole can support the required sign loadings. The Pole Loading 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* and on the Ministry web site in the near future. This program should only be used by designers who have basic knowledge of the Ministry standard equipment and structural design. Refer to *Figure 9* for calculating sign arm lengths.

.10 Use the formula in *Figure 9* to calculate the sign arm length for an L, M or H pole.



A	POLE TYPE
130 mm	L POLE
175 mm	M POLE
200 mm	H POLE

Figure 9. Method of calculating sign arm length

.11 Detailed elevations are required for each pole structure in accordance with *Clause 708.8.*

.1 Elevations for sign poles with electrical equipment illuminated signs 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 companies, the designs shall be well coordinated to maintain consistency.

.12 Where a Type H sign pole is not capable of supporting the required sign size, designers shall use a cantilever or sign bridge structure.

505.3 CANTILEVER AND SIGN BRIDGES 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 Manual* 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 Manual*. A list of these structures and their general applications are as follows:

.1 Cantilever Truss Structure has 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 centre 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 over 14 m where the sign height is less than 2.44 m.

.3 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 centre 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 Regional Traffic Engineer. Generally sign structures are sized to allow for additional signs and expanding 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 (centre to centre) 1/2 the ultimate sign height.

.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 structural engineer shall confirm the base reaction forces based the pole elevation as noted above. The geotechnical engineer will design the foundation shape, size and depth of bury based on the base reaction forces and the soils present. Typically foundation 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 APEGBC. Geotechical and Structural will require both Schedule B1 and B2 forms filled out and signed in accordance with the BC Building Code. All design shall be in accordance with the accepted practice and standards of the Ministry Engineering Section. Refer to generic DS Series drawings in Appendix 700.1 for typical foundations

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

505.4 SINGLE POST SHOULDER MOUNTED 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 the Wood Post Sign Structure Installation Drawings in Section 635, Part D of 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 the Round Steel Post Structure Installation Drawings in Section 635, Part D of 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.*

.5 To calculate the size of post (where variable), designers shall confirm the:

.1 Sign area and the height from the centre 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 SHOULDER MOUNTED 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:

.1 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)).

.2 Are very light duty and will yield upon impact.

.3 Have limited loading capabilities.

.4 Are detailed on the Perforated Square Steel Sign Post Structure Drawings in Section 635, Part D of the Ministry *Standard Specifications for Highway Construction*.

.2 Wood Post Sign Structures:

.1 Are more economical than breakaway sign structures, however, they do not have the equivalent loading capabilities.

.2 Are generally used to mount signs up to 3660 mm wide.

.3 Are detailed on the Wood Post Sign Structure Drawings in Section 635, Part D of the Ministry *Standard Specifications for Highway Construction*.

.3 Steel Breakaway Sign Structures:

.1 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.

.2 Are relatively expensive and should generally be used for signs that are at least 3660 mm.

.3 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.

.4 Are detailed on the Breakaway Sign Structure Drawings in Section 635, Part D of 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 centre 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 spacings 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/UNDERPASS STRUCTURES

.1 Where practical large directional 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 APEGBC. Drawings shall contain specification and design criteria in accordance with Ministry Bridge Engineering standards and general practice. Refer to generic DS Series Drawing in Appendix 700.1 for details

.2 Schedule B1 and B2 in accordance with the BC Building Code

.4 The sign mounting brackets shall be fabricated in accordance with Ministry *Material Standards Manual*, 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 me be found in Appendix 700.1

505.7 SIGN ORDERING

.1 Preparing the sign order is the responsibility of the signing designer. Refer to Section 200 for sign order process.