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Street Lighting Design Guideline

1. PURPOSE

Street lighting generally refers to lighting of streets including sidewalks, crosswalks, intersections, rail crossings, roundabouts, and Multi-use Pathways (MUP's). The main purpose of street lighting is to enhance visibility at night. For a pedestrian, this may mean better visibility of the surrounds and the sidewalk, while for the driver of a motor vehicle, it will mean increased time to stop or to safely maneuver around an obstacle or a pedestrian.

The purpose of this guideline document is to assist the internal and external stakeholders dealing with street lighting design, review and approval of electrical drawings. This document briefly summarizes some of the street lighting design criteria outlined with ANSI/IES RP-8-21. Once the IES publishes a new and updated version of the RP-8-21, this document will become void, as only the current IES design recommended practice for pedestrian and roadway lighting should be followed.

2. DESIGN CRITERIA

2.1. Lighting Design Input Parameters

Two sets of main input parameters are to be used for lighting design criteria:

1. Pedestrian activity;
2. Road classification.

Pedestrian activity can be low, medium, or high, based on the total number of pedestrians walking in both directions, within examined area, during the busiest hour of the night:

Pedestrian Activity	Number of Pedestrians/hr
Low	10 or less
Medium	11 to 100
High	Over 100

Table 1: Pedestrian Activity Levels

The choice of pedestrian activity is an engineering judgement based on the estimated number of pedestrians typically present in area approximately 100m long. Refer to IES RP-8-21 Section 11.3.2 Pedestrian Area Classifications for clarification.

Road classification can be local, collector, arterial (or major).

2.2. Roadway Lighting

The following lighting parameters to be used for roadway lighting design criteria:

- Average luminance Lavg (cd/m^2)
- Average uniformity ratio (Lavg/Lmin)
- Maximum-to-minimum uniformity ratio (Lmax/Lmin)
- Maximum-to-average veiling luminance ratio (LVmax/Lavg)

The following table summarizes the roadway lighting design standards:

Road Classification and Pedestrian Activity		Average luminance Lavg (cd/m^2)	Average uniformity ratio (Lavg/Lmin)	Maximum-to-minimum uniformity ratio (Lmax/Lmin)	Maximum-to-average veiling luminance ratio (LVmax/Lavg)
Road Classification	Pedestrian Activity				
Arterial	High	≥1.2	≤3.0	≤5.0	≤0.3
	Medium	≥0.9	≤3.0	≤5.0	≤0.3
	Low	≥0.6	≤3.5	≤6.0	≤0.3
Collector	High	≥0.8	≤3.0	≤5.0	≤0.4
	Medium	≥0.6	≤3.5	≤6.0	≤0.4
	Low	≥0.4	≤4.0	≤8.0	≤0.4
Local	High	≥0.6	≤6.0	≤10.0	≤0.4
	Medium	≥0.5	≤6.0	≤10.0	≤0.4
	Low	≥0.3	≤6.0	≤10.0	≤0.4

Table 2: Roadway Lighting Design Standards

When undertaking lighting calculations on single-lane or two-lane roadways where the maximum lane width is over the 4m, the width used in the calculation shall be 4m and shall be applied in the travel portion of the roadway starting at the road centre line. This scenario will be most common for Residential or Industrial areas.

Where time limited parking lanes exist or are proposed, the lighting shall be calculated as if the parking lanes are travel lanes. Full time on-street angled, or parallel parking areas shall not be included in the luminance calculations.

Bicycle lanes shall be calculated in luminance as part of the roadway.

2.3. Intersection Lighting

Intersection lighting levels based on various road types and pedestrian activity levels are defined in following table:

Road Classification	Average Maintained Horizontal Illuminance (Lux) at Pedestrian Activity Levels			Average-to-Minimum Uniformity Ratio
	High	Medium	Low	
Arterial/Arterial	≥34.0	≥26.0	≥18.0	≤3.0

Arterial/Collector	≥29.0	≥22.0	≥15.0	≤3.0
Arterial/Local	≥26.0	≥20.0	≥13.0	≤3.0
Collector/Collector	≥24.0	≥18.0	≥12.0	≤4.0
Collector/Local	≥21.0	≥16.0	≥10.0	≤4.0
Local/Local	≥18.0	≥14.0	≥8.0	≤6.0

Table 3: Intersection Lighting Design Standards

2.4. Walkways and Pathways Lighting

Along sidewalks the following lighting design criteria should be met:

Pedestrian Activity	Maintained Average Horizontal Illuminance (Lux)	Average-to-Minimum Horizontal Uniformity Ratio	Minimum Maintained Vertical Illuminance (Lux) – Desired but not Mandatory
High	≥10.0	≤5.0	≥5.0
Medium	≥5.0	≤5.0	≥2.0
Low	≥2.0	≤10.0	≥1.0

Table 4: Walkways and Pathways Lighting Design Standards

If it is decided that lighting should be provided for Multi-Use Pathways (MUP's) which are remote from the roadways, the following design criteria to apply:

- Maintained Average Horizontal Illuminance of 5 Lux or greater.
- Average-to-Minimum Uniformity Ratio of 5:1 or less.

2.5. Adaptive Lighting

Where dimming of the lighting is considered at certain time of day for justified reasons, the lighting designer to complete two sets of calculations for the same roadways, and to provide two sets of street lighting tables – one corresponding to the lighting levels before dimming is applied, and one corresponding to the lighting levels after dimming is applied.

2.6. Use of Glare Shields

The City Engineer may consider use of shields for lighting fixtures that are expected to cause, or have been found to cause, lighting trespass.

3. OTHER CONSIDERATIONS

3.1. Pole Color

Unless specified otherwise, the pole color to be Galvanized and Powder Coated Semigloss Textured Black (nut covers to match pole color). RAL 9005.

3.2. Color Temperature

Unless specified otherwise, lighting color temperature to be 3000K CCT.

3.3. Streetlighting Fixture

Unless specified otherwise, all new street lighting fixtures shall be LED, and for Davit type poles use of the following fixture is recommended:

- LED Roadway lighting, NXT series Fixture: LED Roadway Lighting NXT series fixture, NXT-XX-X-7-2ES-X-XX-4-ULS-2H with adjustable selectable driver. All X's are attributes to be determined by the lighting Consultant to meet City standards for that area. Use of Liveable Cities Cellular Controllers Model No. SLX-E170-7800 also to be considered:
    - Where a new service is provided – Liveable Cities Cellular Controllers Model No. SLX-E170-7800 to be included in design and construction;
    - Where new lights are connected to existing service – Liveable Cities Cellular Controllers Model No. SLX-E170-7800 to be installed on the new fixtures, but to be set to operate as individual photoelectric cell.
- American Electric, AutoBahn fixture American Electric AutoBahn fixture Model No. ATB2-80BLEDEXX-XXX-R2-XX-P7, can be considered for arterial roads with medium and high pedestrian activity.

All new fixtures are required to have 7 pin receptacle (not a 3 pin receptacle), and adjustable selectable driver.

3.4. Underground Conduits

Underground wiring for street lighting shall be designed in accordance with the MMCD Standard Details and this Bylaw, BC Hydro Specifications and shall conform to the rules and regulations of the Canadian Electrical Code (Part 1), the Provincial Electrical Inspection amendments and any City codes or Bylaws and other authorities having jurisdiction.

The standard offset for the location of the underground street lighting ducts within Statutory Right of Way for Highway purposes shall conform to the typical cross-sections.

The minimum depth for the underground ducts shall be 0.6 metres in unpaved areas and 0.9 metres in paved areas. Conduits in non-paved areas shall be concrete encased.

It is the Designer’s responsibility to ensure that the service entrance for street lighting systems is accepted by BC Hydro prior to construction.

3.5. Additional Design Considerations

Street lighting layout will be determined on a case-by-case basis in consultation with City's Traffic Engineering staff. In general:

- All arterial and collector roads shall have street lighting design with staggered pole layout;
- All local roads on 100, 200 and 300 blocks shall have staggered pole layout;
- Pedestrian lighting design by including pedestrian luminaires on a stand-alone 4.3m or 4.5m poles, and/or installed on the back of the roadway lighting poles to be provided for:
    - All arterial and collector roads;
    - All local roads on 100, 200 and 300 blocks;
    - St Andrews Avenue;
    - In vicinity of schools, playgrounds, parks, and other pedestrian generators;
    - As determined by City staff on a case by case bases.

Designer engaged to prepare electrical design for a project located on one side of the road, or at one, two or three intersection corners, is required to prepare a complete design including but not limited to:

- Intersection lighting design, including the proposed lights that will be delivered through the current project and future lights at corners that will be constructed by others through future projects;

- When a staggered layout or opposite pole layout is required, the roadway design shall include the proposed lights that will be delivered through the current project and future lights at opposite site of the road that will be constructed by others through future projects;
- For intersection and roadway lighting calculations, both the proposed and the future lights shall be considered;

Existing BC owned lease lights shall not be included in lighting calculations. When applicable, removal of existing BC Hydro lease lights shall be considered after City owned lights are commissioned.

Designers working on a street lighting or intersection design on corridors that are on the City plan for future fibre network expansion, shall include empty fibre conduits along the new street lighting conduits and junction boxes for future fibre. Specifications for the empty conduits and junction boxes for future fibre expansion:

- Concrete Junction Box 5686 METER BOX 15 inch GROOVE TOP WITH K/O;
- New conduit installations shall use 76mm (3") Rigid Type DB/2 PVC conduit for direct bury/concrete applications. If possible the ducts shall be orange in color;
- Only prefabricated factory 90-degree bends (long sweep) are to be use to change conduit direction;
- Prefabricated factory conduit "bell" type end fitting are to be used when ducts enter pull box, manhole, vault, hand hole or other equivalent transitional space;
- Minimum of 2x76mm conduits will be installed during a new installation unless site conditions prevent it.

The following corridors are on the City plan for future fibre network expansion:

- Chesterfield Avenue;
- St Georges Avenue;
- East 3rd Street;
- West 3rd Street;
- Lonsdale Avenue;
- 23rd Street;
- Fell Avenue.

3.6. Areas with unique specifications

The following areas have unique specifications. Please contact City's representative from Traffic Operations/Engineering for additional details:

- Marine Drive
- Esplanade
- Lonsdale
- Harbourside / Automall
- Spirit Trail
- Green Necklace Trail
- Victoria Park
- Waterfront Park
- Jack Loucks Court
- Shipyards
- Rogers
- Carrie Cates
- Pedestrian Precinct areas (generally within 1 block of the above areas) see Map 1 on pg. 33/135 for detailed info http://www.cnv.org//-/media/city-of-north-vancouver/documents/transportation-plan/long-term-transportation-plan.pdf

Local roads shall be designed 7.6m galvanized powder coated black Davit poles. Collector and Arterial roads shall be designed with one piece 9.1m or 10.7m galvanized powder coated black poles and 2.4m arms. Typical pedestrian lighting shall be designed with 4.3m to 4.5m poles per City of North Vancouver design detail E1P.

3.7. Clearance to BC Hydro Lines

The requirements of BC Hydro, Canadian Electrical Code, BC Electrical Inspectors Branch, and the WorkSafeBC, shall be followed with respect to clearances between streetlight poles, luminaires, high voltage and other conductors.

Where BC Hydro clearances to poles and luminaires cannot be met BC Hydro Lease
Lighting may be considered only when the Designer can prove no viable City owned lighting options exist. This shall include shorter than standard poles or locate poles on the opposite side of the road than the overhead power lines. BC Hydro Lease lights shall meet the required light levels defined unless approved by the City.

3.8. Power Supply and Distribution

Power is generally supplied by BC Hydro through an un-metered service when servicing only streetlights and traffic signals. Where tree lights, irrigation controllers and pole receptacles are included, BC Hydro may require a metered service. This shall be confirmed with the City and BC Hydro.

The designer shall confirm voltage and locations of suitable power sources for the proposed lighting system. The Designer shall confirm if a new service is required or an existing lighting system in the area is suitable for extension. Lighting systems are typically serviced from a 120/240 Volt single phase 3 wire system. Use of other voltages must be approved by the Engineer.

Services are to be “Underground Dip” type or will tie into a service box. The Designer shall select a suitable service location based on availability and what meets the City and BC Hydro standards.

(The BC Hydro power supply needs to feed into a service base which shall contain panel boards, breakers, lighting contactor(s), switch and surge protector. The lighting is controlled by a single photocell located on a luminaire. The service base shall be located:

- Off the roadway where not likely to be impacted by motor vehicles.
- Where it will not be a hazard or obstruction to pedestrians
- Where it can be accessed for easy servicing and
- To accommodate extension to future lights within the road dedication and not on private property.

Service conduit shall be minimum 53mm RPVC.

Power distribution requirements include:

- Wiring to be installed in minimum 35mm Rigid PVC conduit.
- Wiring to be stranded copper with RW90 insulation.
- Wiring to be colour coded per Canadian Electrical Code (CEC) and
- Conduit burial depth as per City Standards.
- Conduit alignments shall be designed to avoid tree roots.

3.9. Design

Lighting design requires computer lighting calculations using AGI32 and lighting supplier photometric files in the IES format.

The Designer shall select luminaires with optical systems which efficiently light the interned area and properly illuminate the Roadway and Sidewalks as well as provide maximum spill light control beyond the Sidewalk in order to reduce spill light and glare impacts on residents.

The Designer shall apply Light Loss Factor of 0.85 to the lighting design.

Electrical design requirements include:

- Maximum voltage drop for branch circuits: 3%;
- Allow for possibility of future expansion. Stub out conduit(s) at the last streetlight pole and / or into a temporary junction box at end of the development.
- Junction boxes shall be installed where required and shall not be installed within the Sidewalk.
- Conductor sizes: #6 RW90 in conduit and #12 RW90 in the poles from luminaire to the pole handhole.
- Circuit load not to exceed 80% of feeder breaker rating (as per CEC).

The Designer shall submit lighting and voltage drop calculation with their design. Voltage drop and lighting calculations shall be submitted in PDF and shall be signed and sealed by the Designer.

Drawings shall include a Lighting Design Table which reflects the proposed design as per the example below.

LIGHTING DESIGN TABLE		
ITEM	DESCRIPTION	
LIGHTING PROGRAM	AGI32	
STREET NAME(S)	ROAD	
LAND USE	INDUSTRIAL	
ROADWAY CLASSIFICATION	MAJOR	
PAVEMENT CLASSIFICATION	R3	
ROADWAY WIDTH (m)	18m (STG, STA. #88+60)	
MEDIAN WIDTH (m)	N/A	
LUMINAIRE DESCRIPTION/PRODUCT NUMBER	ATB0 P451 MVOLT R2 4K NL P7 SH	
PHOTOMETRIC FILE No.	ATB0_P451_R2_4K.ies	
LAMP WATTAGE & LIGHT SOURCE	105W LED (4000K)	
INITIAL LAMP LUMENS	15759 (ABSOLUTE)	
LIGHT LOSS FACTOR	LLF(0.78) = LLD (0.9) x LDD (0.89) x EF (0.95) x TF (1.03) x CF (1.0)	
LUMINAIRE DISTRIBUTION TYPE	TYPE II	
LUMINAIRE BUG RATING	B3–U0–G3	
LUMINAIRE TILT OR SPIN (IF APPLICABLE)	N/A	
LUMINAIRE MOUNTING HEIGHT (m)	9.14	
POLE HEIGHT (m)	9.14	
POLE SETBACK (m)	0.6 – 2.2m (FROM BACK OF CURB)	
POLE ARM LENGTH (m)	2.3	
POLE ARRANGEMENT	STAGGERED	
POLE SPACING	45m (MAX)	
SURROUND RATIO		
ITEM	RECOMMENDED VALUES	ACHIEVED VALUES
SURROUND RATIO	0.8:1	0.8:1
LUMINANCE DESIGN CRITERIA – ROADWAY		
ITEM	RECOMMENDED VALUES	ACHIEVED VALUES
LUMINANCE LEVEL (Lavg) IN cd/m^2	0.9	1.9
UNIFORMITY RATIO (L_{avg}/L_{min})	3.0:1	2.1:1
UNIFORMITY RATIO (L_{max}/L_{min})	5.0:1	4.2:1
VEILING LUMINANCE RATIO (LV_{mav}/L_{avg})	0.3:1	0.3:1