

Jim Robertson's Edits (1/14/2013)

I. **GENERAL** ~~[So not redundant of II, below.]~~ **REQUIREMENTS**

- A. Purpose and Intent: The standards of ARTICLE 2.5 are intended to provide high quality exterior lighting to:
1. Meet the intent in Sections 1.1 and 2.1 of this Subchapter.
 2. Protect the outdoor ~~lighting~~ environment by reducing light pollution (also called sky glow) and light trespass (often described a light shining across property lines).
 3. Provide for safety and security of people and property.
 4. Provide a balance between protecting residential neighborhoods and design creativity.
 5. Accommodate applications of new lighting technology, such as LEDs.
- B. This Section relies on other standards (such as IECC and ASHRAE) to provide exterior lighting that is energy efficient, and environmentally sensitive by limiting the total wattage of exterior site lighting. By limiting wattage, these codes and standards limit overall site brightness.
- C. Conformance with Applicable Codes – All exterior lighting subject to this ordinance shall be installed in conformance with provisions of this Subchapter and all other applicable codes.

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Comment [JR1]: Spell these acronyms out the first time they are used.

II. **GENERAL REQUIREMENTS FOR ALL PROJECTS**

A. LIGHTING CONTROL REQUIREMENTS

1. All exterior light fixtures shall be turned off when the amount of ambient natural light meets the recommended illuminance levels for safety and the intended use(s) of the space(?). This is generally perceived to be during daylight hours.
2. All luminaires used for the following applications must be turned off during CURFEW (Note: can we be more specific as to curfew hours, i.e. between 10:00 p.m. and 6:00 am?) hours:
 - a. Landscape lighting.
 - b. All lighting classified as exempt ~~(including decorative luminaires OR the uplight portion of a light fixture)~~ from the full cut off or fully shielded requirement of other portions of this ordinance.
 - c. External, ground mounted lighting for a sign.
 - d. All luminaires used for aesthetic enhancement of building or site features including uplighting and facade lighting.
- e. Control of exterior lighting shall be provided by an automatic control device or system such as a photo sensor, astronomic time control or equivalent functions from a programmable lighting controller, building automation system or lighting energy management system.

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Comment [JR2]: I don't think this phrase is necessary.

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3.

~~f.4.~~ Exception: Interior lighting installed in tunnels, entrance and exit driveways of parking garages, and similar conditions where lighting level is related to safety.

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B. REQUIREMENT FOR PARKING GARAGES OR COVERED PARKING CANOPIES

1. Interior light fixtures located in vehicle areas of structured parking are not required to be full cutoff or fully shielded.
2. Light fixtures installed on an uncovered level of a parking garage shall be full cut off or fully shielded.
3. Light fixtures installed in stairs open on one or more sides shall be full cut off or fully shielded.
4. Light fixtures installed in covered parking canopies shall be full cut off or fully shielded.

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III. **PREScriptive CONTEXT-SENSITIVE METHOD:** ~~All exterior lighting, unless otherwise exempt, shall comply with ALL of the following requirements. (Note: this probably isn't the best title for this section but I think the current, or a revised version of the current lighting, should be the **PREScriptive METHOD**)~~

[Seems like the most logical sequence for this section describing the Prescriptive Method would be:

1. State the general requirement: "All exterior lighting shall be classified as FULL CUT OFF or FULLY SHIELDED.
2. State the exemption (Part B below). Within that statement of exemption, include the content of Item B4 below, clarifying that the exemption is only for the classification. Also, within the exemption section, include a sub-section identifying the exceptions to the exemption. These exemptions should include Part A below, which states that the exemption is not available for luminaires located within 100' of property zoned SF-5, and the exceptions identified in Items 5a, 5b, and 5c below.
3. State the DIRECT VIEW LIGHTING provision.
4. Etc.

III.

- A. All luminaires located within 100 feet of a property zoned SF-5 or more restrictive zoning district shall be classified as FULL CUT OFF or shall be ~~fully-shielded~~**FULLY SHIELDED**, regardless of ~~location on the site or~~**TOTAL FIXTURE LUMENS**. These fixtures are not eligible for exemptions identified in subsection C, below:
- B. EXEMPTION: Luminaires with less than 1,800 **TOTAL FIXTURE LUMENS** shall be exempt from the FULL CUTOFF or FULLY SHIELDED requirement provided all the following are met:
 1. **TOTAL FIXTURE LUMENS** from ALL exempt luminaires on the site shall not exceed the limits in the following table.

LIGHTING ZONE	MAXIMUM LUMENS FROM EXEMPT LUMINAIRES
LZ1	None allowed in City without prior written approval of building official.
LZ2	2% of total site lumens
LZ3	5% of total site lumens
LZ4	None allowed in City without prior written approval of building official.
SEE APPENDIX FOR DEFINITIONS OF LIGHTING ZONES.	

2. ~~Direct view lighting~~**DIRECT VIEW LIGHTING** shall be allowed subject to the following:
 - a. ~~Direct view lighting~~**DIRECT VIEW LIGHTING** shall emit no more than 250 lumens per linear foot OR per source.
 - b. Total lumen output of ~~direct view lighting~~**DIRECT VIEW LIGHTING** shall be included in the maximum exempt lumen calculation and shall be subject to the limits shown above.
3. ~~All exempt luminaires must be turned off during curfew hours.~~
4. Exemption under this section is for cut off and shielding classification only. Fixtures must comply with all other requirements of this ordinance.
5. The following are NOT eligible for this exemption:
 - a. Lighting in surface parking lots, uncovered levels of structured parking (typically the top-most parking level) and related drives (whether surface or structured), roadways and similar vehicle drive areas.
 - b. Luminaires installed at mounting heights at or above 16 feet above grade, regardless of fixture type.
 - c. All building entrances and exits intended for staff or employee use (not a public entrance).

C. LUMINAIRE MOUNTING **HEIGHT**

1. All ground mounted, pole mounted or wall mounted luminaires must be installed at least 3 times their mounting height from the property zoned SF-5 or more restrictive. Where an opaque barrier/obstruction is in place

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Comment [JR3]: We still need to resolve the mounting height issue – as it relates to sloped sites. We have discussed substituting a point-by-point analysis, but I am reluctant to go that route because it might impose an unreasonable burden on small projects. Might we be able to adjust the formula for MOUNTING HEIGHT so as to take into account slope?

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between the luminaire and the property line, the height of the opaque barrier may be added to the allowed luminaire mounting height. A wood privacy fence shall be considered an opaque barrier provided the openings between boards do not exceed 0.125 inches. See the following.

$$D = (MH - Hob) \times 3 \quad \text{and} \quad MH = (D/3) + Hob$$

where

D = horizontal distance between luminaire and property line

MH = mounting height of luminaire measured from ground or paving surface and light fixture lens or bottom-most portion of reflector

Hob = height of opaque barrier installed on applicant side of property line

2. Exception: The following applications shall be exempt from the requirement on LUMINAIRE MOUNTING HEIGHT:

- a. Luminaires installed inside or on the top level of a parking structure
- b. Luminaires installed in a vehicular tunnel

3. Landscape material or significant changes in grade will be considered on a case-by-case basis and must use the PERFORMANCE METHOD/ALTERNATIVE EQUIVALENT COMPLIANCE METHOD to determine if an opaque barrier is effective at reducing light trespass.

4. Where compliance with this paragraph is not possible due to site conditions or other factors, the project must comply with the PERFORMANCE/ALTERNATIVE EQUIVALENT COMPLIANCE METHOD.

D. Required Documentation – Prescriptive Method

1. Luminaire product data sheets or manufacturer's shop drawings, annotated to illustrate total luminaire wattage, number of lamps in luminaires, accessories/options, and mounting.
 - a. FOR FULL CUT-OFF FIXTURES: The IES Luminaire Classification (FULL CUTOFF, NON-CUTOFF, SEMI-CUTOFF, and NON-CUTOFF) shall be shown in the document submitted in accordance with paragraph 1 above OR a photometric report shall be submitted showing cut-off classification.
 - b. FOR FULLY SHIELDED FIXTURES: The documents submitted in accordance with paragraph 1 above shall include photos or drawings illustrating that the fixture complies with fully shielded requirement.
2. Lamp product data sheets indicating lumen output of lamps used for each Luminaire
3. Cut sheets demonstrating Lighting Controls products.
4. A schedule (see appendix for sample format) showing the following:
 - a. Total LUMINAIRE LUMENS (based on number of lamps used in each luminaire) for each luminaire
 - b. Total quantity of each luminaire on the site
 - c. Total lumens for site
 - d. Percent of exempt fixture lumens relative to site lumens
5. Documents depicting all exterior fixtures on the site (including those attached to building and in soffits or overhang) showing the following:
 - a. Mounting heights of luminaires (site and building) showing height above adjacent grade or surface.
 - b. Control schematics, diagrams or narrative demonstrating compliance with controls requirements.
 - c. Location of all adjacent property zoned SF-5 or more restrictive.

Comment [JR4]: If these applications are going to be exempt from the MOUNTING HEIGHT requirement, then how are we going to handle them (especially those on top of a garage)? I don't think we can leave them un-regulated.

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IV. ALTERNATIVE EQUIVALENT COMPLIANCE METHOD

COA DESIGN GUIDE LIGHTING REVIEW / SECTION 2.5 / EXTERIOR LIGHTING / C Thompson comments

- A. For the ALTERNATIVE EQUIVALENT COMPLIANCE method, the exterior lighting design must comply with ONE of the following:
1. 2009 USGBC LEED Sustainable Site Credit 8
 2. 2011 IDA-IES MODEL LIGHTING ORDINANCE (MLO)
- B. Required documentation – Alternative Equivalent Compliance Method
1. All documentation required for PRESCRIPTIVE METHOD, shown above.
 2. Industry standard point-by-point illuminance model illustrating compliance with maximum illuminance levels. Model shall be as follows:
 - a. Illuminance points shall be modeled at finished grade with maximum grid spacing of 10 foot by 10 foot.
 - b. Points shall be shown in horizontal FCs and shall be shown with two decimal places of accuracy.
 - c. Light loss factor shall be 0.90.

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C. All documentation submitted for Alternative Equivalent Compliance Method shall bear the seal of an architect, professional engineer or landscape architect licensed in the State of Texas.

V. **Miscellaneous requirements for all luminaires**

- A. Installation of luminaires shall not change performance of light output related to cutoff classification or fully shielded classification.
- B. All luminaires shall be maintained in good working order to comply with requirement of this ordinance.

VI. **Non-conforming lighting:** Non-conforming luminaires existing on the date this ordinance is passed shall be replaced with complying fixtures when:

- A. The non-conforming luminaire is replaced due to needed repairs.
- B. The property is rezoned for a change of use.
- C. The property is remodeled and over 50 percent of the exterior lighting (based on luminaire count) is replaced.

VII. **Applicability:** This ordinance applies to all exterior lighting systems for new construction and existing building renovations, with the following exceptions:

- A. Lighting for **theatrical purposes**, including performance, stage, film production, and video production in use for no more than 10 days per year. The building official may permit installations or performances in excess of 10 days per year.
- B. Lighting used to highlight features of public monuments and registered historic landmark structures or buildings.
- C. Specialized signal, directional, and marker lighting associated with transportation.
- D. Temporary lighting for seasonal proposes provided that the individual lamps are less than 200 lumens per lamp and used for no more than 60 days.
- E. Internally-lit and/or back lit advertising signage or directional signage (where light source is not visible from any angle).
- F. Underwater lighting in swimming pools or water features.
- G. Emergency lighting which is normally off.
- H. Uplighting for **Government Flags** **GOVERNMENT FLAGS**.
- I. Lighting specified or identified in a specific use permit.
- J. Lighting required by federal or state laws or regulations.
- K. Single family residential provided the total fixture lumens do not exceed 3,600 lumens.

Comment [JR5]: I think this section could be part of Part II ("General Requirements for all projects."

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Comment [JR6]: Need to coordinate any language used here with the code amendments currently being processed regarding Subchapter E applicability.

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Comment [JR7]: Does this include music performance?

Comment [JR8]: And need to provide definition. Best definition would be one that is already used in LDC. If not already defined within LDC, then perhaps something like, "A flag designated as the official flag of a governmental entity, including federal, state, or local entities."

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III. **Definitions**

ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
CURFEW hours	Hours from 30 minutes after close of business to 30 minutes before opening of business. Where no business exists on a site, curfew hours shall be from 1100pm to 0500am.
DIRECT VIEW LIGHTING	Bare bulb lighting, neon lighting or neon-like led lighting typically used for accent lighting, lighting outlining a building or site element. Includes any bare bulb installed without an enclosure or housing surrounding the bulb.
FULLY SHIELDED	A luminaire with an opaque housing, opaque closed top, and no lens or lamp extending below the housing shall be deemed to comply with the FULL CUTOFF requirement of this ordinance. No photometric test report will be required and annotations of FULL CUTOFF will not be required on the product data sheet. Any fixtures meeting this requirement shall have ZERO lumens above 90 degrees. Fully recessed downlights shall meet this qualification. Additionally, a luminaire may be shielded by external features of the building
IECC	International Energy Conservation Code
IES	Illuminating Engineering Society
LUMINAIRE Also LIGHT FIXTURE	A complete lighting unit consisting of a lamp or lamps and ballast(s) (when applicable) together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.
DUAL OPTIC LUMINAIRE	A luminaire with two separate optical compartments, for example combined uplight and downlight light distribution. A dual optic luminaire shall be considered fully shielded provided the following: <ul style="list-style-type: none"> • The non-complying portion of the luminaire is wired for control to turn off after curfew. • The non-complying portion of the luminaire is less than 1,800 total lumens. • The non-complying portion of the luminaire complies with the MAXIMUM LUMENS FROM EXEMPT LUMINAIRES • The downlight portion of the luminaire complies with the definition of a fully shielded luminaire and all other portions of this ordinance.
TOTAL FIXTURE LUMENS	The cumulative total of initial lumens emitted by all lamps contained within a single luminaire.
USGBC	U.S. Green Building Council

CUT OFF CLASSIFICATION	
FULL CUTOFF	A luminaire light distribution where zero candela intensity occurs at or above an angle of 90 degrees above nadir (straight down). Additionally, the candela per 1,000 lamp lumens does not numerically exceed 100 (10%) at or above a vertical angle of 80 degrees above nadir. This applies to all lateral angles around the luminaire.
CUTOFF	A luminaire light distribution where the candela per 1,000 lamp lumens does not numerically exceed 25 (2.5%) at or above and angle of 90 degrees above nadir (straight down), and 100 (10%) at or above vertical angle 80 degrees above nadir. This applies to all lateral angles around the luminaire.
SEMI-CUTOFF	A luminaire light distribution where the candela per 1,000 lamp lumens does not numerically exceed 50 (5%) at or above an angle of 90 degrees above nadir (straight down), and 200 (20%) at or
NON-CUTOFF	A luminaire light distribution where there is no candela limitation in the zone above maximum candela.

Comment [JR9]: I think there may be a few terms included here (e.g., Dual Optic Luminaire, Semi-Cutoff, Non Cutoff, etc.) that are not used within the body of the rules. If that is the case, then those terms need not be defined.

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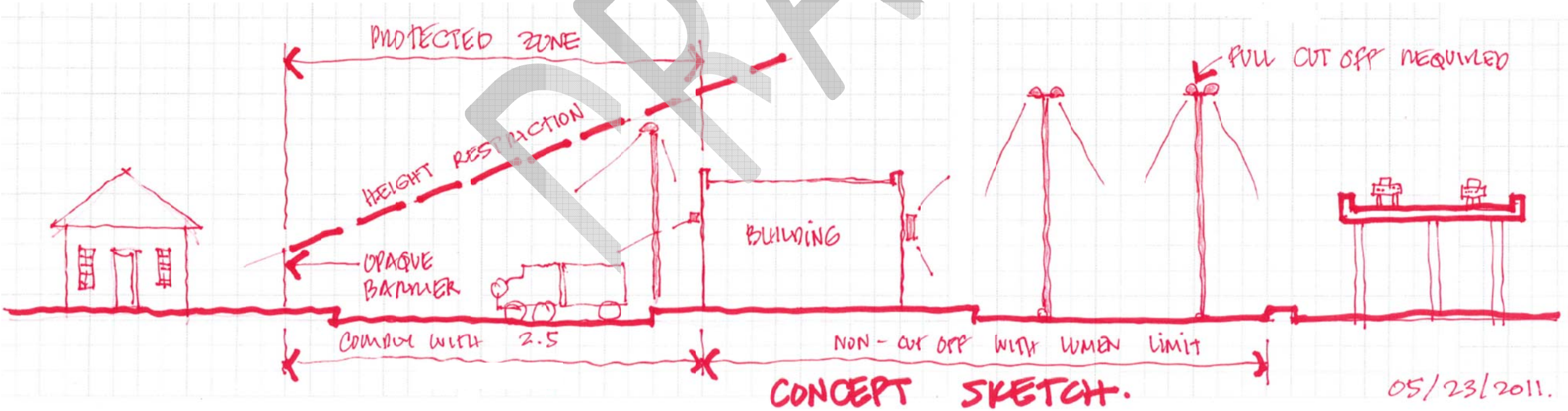
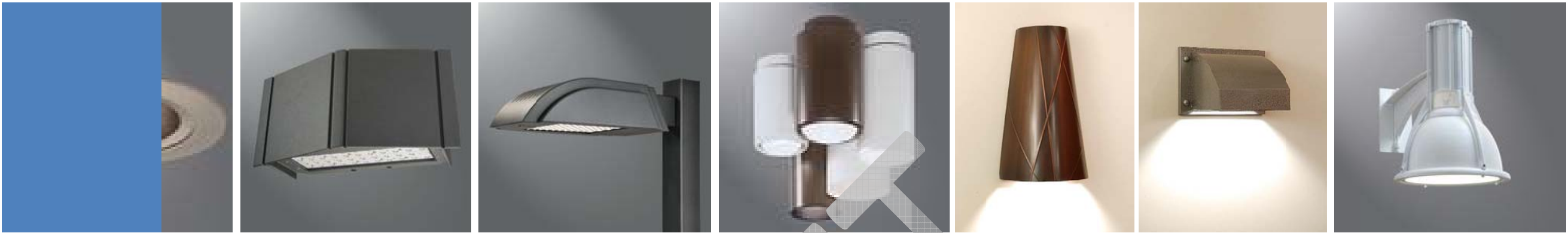
LIGHTING ZONES	
LZ1	<i>Areas with intrinsically dark landscapes.</i> Examples are national parks, areas of outstanding natural beauty, or residential areas where inhabitants have expressed a strong desire that all light trespass be strictly limited.
LZ2	<i>Areas of low ambient brightness.</i> These may be outer urban and rural residential areas. Roadways may be lighted to typical <i>residential</i> standards
LZ3	<i>Areas of medium ambient brightness.</i> These will generally be urban residential areas. Roadways will normally be lighted to typical traffic route standards.
LZ4	<i>Areas of high ambient brightness.</i> Normally these are urban areas having both residential and commercial use and experiencing high levels of night time activity.

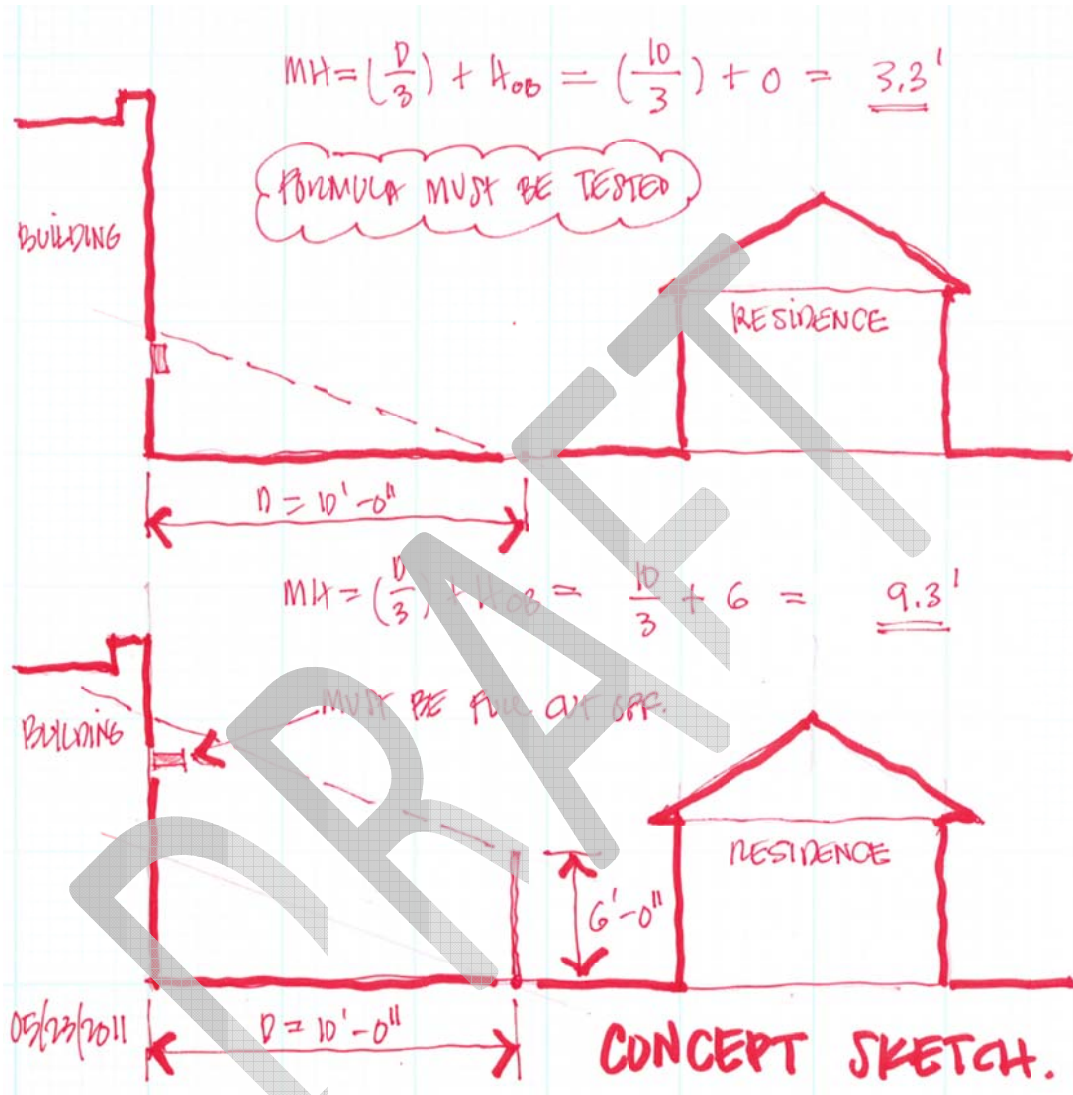
SAMPLE SCHEDULE FOR PRESCRIPTIVE PERFORMANCE METHOD

REF	SOURCES			FIXTURE LUMENS		TOTAL LUMENS	MTG HT	IES CLASS	COMMENTS
	TYPE & WATTAGE	QTY	LUMENS EACH	CUT OFF	NON CUT OFF				
A	250 W METAL HALIDE	2	24,000	48,000		80,000	30 FT	FULL CUTOFF	
B	400 W METAL HALIDE	20	42,000	840,000		840,000	30 FT	FULL CUTOFF	
C	100 W METAL HALIDE	1	9,000	9,000		9,000	12 FT	FULL CUTOFF	
D	42 W CFL	6	3,200	19,200		19,200	10 FT	FULL CUTOFF	DOWNLIGHT
E	18 W CFL	10	1,200		12,000	12,000	8 FT	NON-CUTOFF	
COLUMN TOTALS				916,200	12,000	960,200			
PERCENT LUMENS LEAVING SITE				1.25%					

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SS Credit 8: Light Pollution Reduction

1 Point

Intent

To minimize light trespass from the building and site, reduce sky-glow, increase night sky access, improve nighttime visibility through glare reduction and reduce development impact from lighting on nocturnal environments.

Requirements

Project teams must comply with 1 of the 2 options for interior lighting AND the requirement for exterior lighting.

For Interior Lighting

OPTION 1

Reduce the input power (by automatic device) of all nonemergency interior luminaires with a direct line of sight to any openings in the envelope (translucent or transparent) by at least 50% between 11 p.m. and 5 a.m. After-hours override may be provided by a manual or occupant-sensing device provided the override lasts no more than 30 minutes.

OR

OPTION 2

All openings in the envelope (translucent or transparent) with a direct line of sight to any nonemergency luminaires must have shielding (controlled/closed by automatic device for a resultant transmittance of less than 10% between 11 p.m. and 5 a.m.).

For Exterior Lighting

Light areas only as required for safety and comfort. Lighting power densities must not exceed ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda¹) for the classified zone. Meet exterior lighting control requirements from ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda¹) Exterior Lighting Section, without amendments.

Classify the project under 1 of the following zones, as defined in IESNA RP-33, and follow all the requirements for that zone:

1/1: Dark (developed areas within national parks, state parks, forest land and rural areas)

Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.01 horizontal and vertical footcandles at the site boundary and beyond. Document that 0% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

¹ Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied to the entire project.

² Urban areas shall be designated by an organization with local jurisdiction, such as the local zoning authority.

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LZ2: Low (primarily residential zones, neighborhood business districts, light industrial areas with limited nighttime use and residential mixed-use areas)

Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 10 feet beyond the site boundary. Document that no more than 2% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ3: Medium (all other areas not included in LZ1, LZ2 or LZ4, such as commercial/ industrial, and high-density residential)

Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ4: High* (high-activity commercial districts in major metropolitan areas)

Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.50 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 10% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ2, LZ3 and LZ4 - For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

For All Zones

Illuminance generated from a single luminaire placed at the intersection of a private vehicular driveway and public roadway accessing the site is allowed to use the centerline of the public roadway as the site boundary for a length of 2 times the driveway width centered at the centerline of the driveway.

Potential Technologies & Strategies

Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution.

Minimize site lighting where possible, and use computer software to model the site lighting. Technologies to reduce light pollution include full cut off luminaires, low reflectance surfaces and low-angle spotlights.

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