

Advancements in Lighting

A Peek at the New Lighting Requirements
for ASHRAE/IESNA Standard 90.1-2010
Applicable to Retailers

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Standard 90.1 Basics

- ▶ Jointly sponsored by ASHRAE and IESNA
- ▶ 2007 is the current published version...but many states have older versions in place (2004, 2001, 1999, 1989)
- ▶ Many State-specific codes and the IECC are based on 90.1. IECC references 90.1 as compliance option
- ▶ 2004 version is the commercial building energy code reference in NFPA 5000



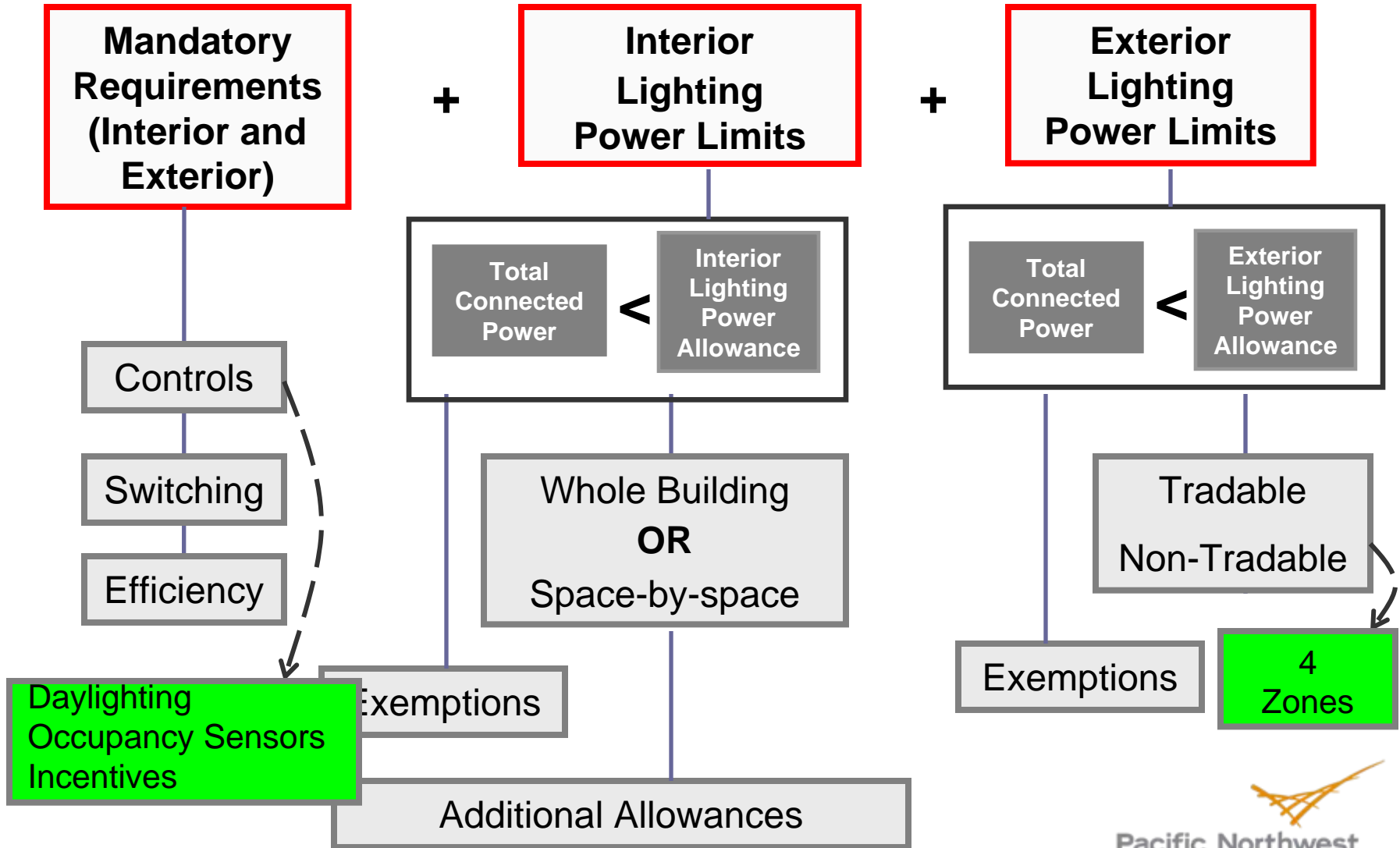
The
LIGHTING
AUTHORITY



Review of Changes for 2010 – Caveats

- ▶ As of today these changes are either:
 - Approved as addenda to 90.1-2007
 - OR**
 - Proposed as addenda to 90.1-2007 (in review process)
 - OR**
 - Under consideration (in subcommittee)
- ▶ When these become part of 90.1-2010.....they will **only** be effective when 90.1-2010 is adopted by a jurisdiction
- ▶ Note that some of these provisions will find there way into upcoming versions of IECC.

Basic Lighting Requirements



Occupancy Based Control Additions

Requirement for specific occupancy sensor control in additional spaces (red).

- conference, meeting rooms, and training rooms,
- classrooms and lecture halls
- employee lunch and break rooms.
- storage and supply rooms up to 1000 ft²,
- rooms used for document copying and printing,
- office spaces up to 250 ft²,
- restrooms
- dressing, locker, and fitting rooms.

*[Addenda “x” to 90.1-2007 –
Completed review]*

Exceptions updated (moved):

- Spaces with multi-scene lighting control systems
- Shop and laboratory classrooms
- Spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s)
- Lighting required for 24-hour operation

Occupancy Manual-on Control Requirement

Automatic control devices shall not be set to Automatically turn the lighting on.

- ▶ This effectively requires manual-on function for automatic controls
- ▶ Commonly known as a “vacancy sensor” in occupancy sensor industry

Exceptions (where automatic-on is allowed):

- ▶ public corridors and stairwells,
- ▶ restrooms,
- ▶ primary building entrance areas and lobbies ,
- ▶ areas where manual-on operation would endanger the safety or security of the room or building occupant(s).

[Addenda “aa” to 90.1-2007 - Approved]

Zonal Exterior Power Allowance Revision

- ▶ The existing single set of exterior power limits is expanded to be lighting zone based.
- ▶ Follows the current IESNA development work on Model Lighting Ordinances (MLO)

Exterior Lighting Zones

Lighting Zone	Description
1	Developed areas of National Parks, State Parks, Forest Land, and Rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas
4	High activity commercial districts in major metropolitan areas as designated by the local jurisdiction

[Addenda “i” to 90.1-2007 - completed review]

Zonal Exterior Power Allowance Revision

		<u>Zone 1</u>	<u>Zone 2</u>	<u>Zone 3</u>	<u>Zone 4</u>
<u>Base Site Allowance</u>		<u>500 W</u>	<u>600 W</u>	<u>750 W</u>	<u>1300 W</u>
Tradable Surfaces	Uncovered Parking Areas				
	Parking <u>areas</u> and drives	<u>0.04 W/ft²</u>	<u>0.06 W/ft²</u>	<u>0.10 W/ft²</u>	(0.15) <u>0.13 W/ft²</u>
	Building Grounds				
	Walkways less than 10 feet wide	<u>0.7 W/linear foot</u>	<u>0.7 W/linear foot</u>	<u>0.8 W/linear foot</u>	1.0 W/linear foot
	Walkways 10 feet wide or greater Plaza areas Special Feature Areas	<u>0.14 W/ft²</u>	<u>0.14 W/ft²</u>	<u>0.16 W/ft²</u>	0.2 W/ft ²
	Stairways	<u>0.75 W/ft²</u>	<u>1.0 W/ft²</u>	<u>1.0 W/ft²</u>	1.0 W/ft ²
	<u>Pedestrian Tunnels</u>	<u>0.15 W/ft²</u>	<u>0.15 W/ft²</u>	<u>0.2 W/ft²</u>	<u>0.3 W/ft²</u>
	<u>Landscaping</u>	<u>0.04 W/ft²</u>	<u>0.05 W/ft²</u>	<u>0.05 W/ft²</u>	<u>0.05 W/ft²</u>

Zonal Exterior Power Allowance Revision

		<u>Zone 1</u>	<u>Zone 2</u>	<u>Zone 3</u>	<u>Zone 4</u>
Tradable Surfaces	Building Entrances and Exits				
	Main entries	<u>20 W/linear foot of door width</u>	<u>20 W/linear foot of door width</u>	<u>30 W/linear foot of door width</u>	30 W/linear foot of door width
	Other doors	<u>20 W/linear foot of door width</u>	<u>20 W/linear foot of door width</u>	<u>20 W/linear foot of door width</u>	20 W/linear foot of door width
	<u>Entry Canopies</u>	<u>0.25 W/ft²</u>	<u>0.25 W/ft²</u>	<u>0.4 W/ft²</u>	(1.25) <u>0.4 W/ft²</u>
	<u>Sales Canopies</u>				
	free standing and attached	<u>0.6 W/ft²</u>	<u>0.6 W/ft²</u>	<u>0.8 W/ft²</u>	(1.25) <u>1.0 W/ft²</u>
	<u>Outdoor Sales</u>				
	Open areas (including vehicle sales lots)	<u>0.25 W/ft²</u>	<u>0.25 W/ft²</u>	<u>0.5 W/ft²</u>	(0.5) <u>0.7 W/ft²</u>
	Street frontage for vehicle sales lots in addition to “open area” allowance	<u>No allowance</u>	<u>10 W/linear foot</u>	<u>10 W/linear foot</u>	(20) <u>30 W/linear foot</u>

Zonal Exterior Power Allowance Revision

Non-Tradable Surfaces	Building Facades	No allowance	<u>0.1 W/ft² for each illuminated wall or surface or 2.5 W/linear foot for each illuminated wall or surface length</u>	<u>0.15 W/ft² for each illuminated wall or surface or 3.75 W/linear foot for each illuminated wall or surface length</u>	0.2 W/ft ² for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length
	Automated teller machines and night depositories	<u>270 W per location plus 90 W per additional ATM per location</u>	<u>270 W per location plus 90 W per additional ATM per location</u>	<u>270 W per location plus 90 W per additional ATM per location</u>	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded fac.	<u>0.75 W/ft² of covered and uncovered area</u>	<u>0.75 W/ft² of covered and uncovered area</u>	<u>0.75 W/ft² of covered and uncovered area</u>	(1.25) <u>0.75 W/ft² of covered and uncovered area</u>
	Loading areas for law enforcement, fire, ambulance and other emergency service vehicles	<u>0.5 W/ft² of covered and uncovered area</u>	<u>0.5 W/ft² of covered and uncovered area</u>	<u>0.5 W/ft² of covered and uncovered area</u>	0.5 W/ft ² of <u>covered and uncovered area</u>
	Drive-up windows/<u>doors</u>	<u>400 W per drive-through</u>	<u>400 W per drive-through</u>	<u>400 W per drive-through</u>	400 W per drive-through
	Parking near 24-hour retail entrances	<u>800 W per main entry</u>	<u>800 W per main entry</u>	<u>800 W per main entry</u>	800 W per main entry

Daylighting Changes.....

- ▶ Three separate addenda (“d”, “ab”, “al”) that:
Require the control of electric lighting when top and side daylight is present
...AND...
Require the design and installation of skylights when appropriate
- ▶ Developed with DOE funded subcontract – Heschong-Mahone Group
- ▶ Based on previous work for California Title 24

Lighting Control for Toplighting

Requires control of electric lighting when toplighting daylight is available

- ▶ Applied based on “daylight area under skylights” + “daylight area under rooftop monitors” that exceed 4000 ft²
- ▶ Control is required for the general lighting over these areas
- ▶ Control must be multi-level photocontrol
 - At least two output levels at 0% - 35% and 50% - 70%
 - OR
 - Continuous dimming

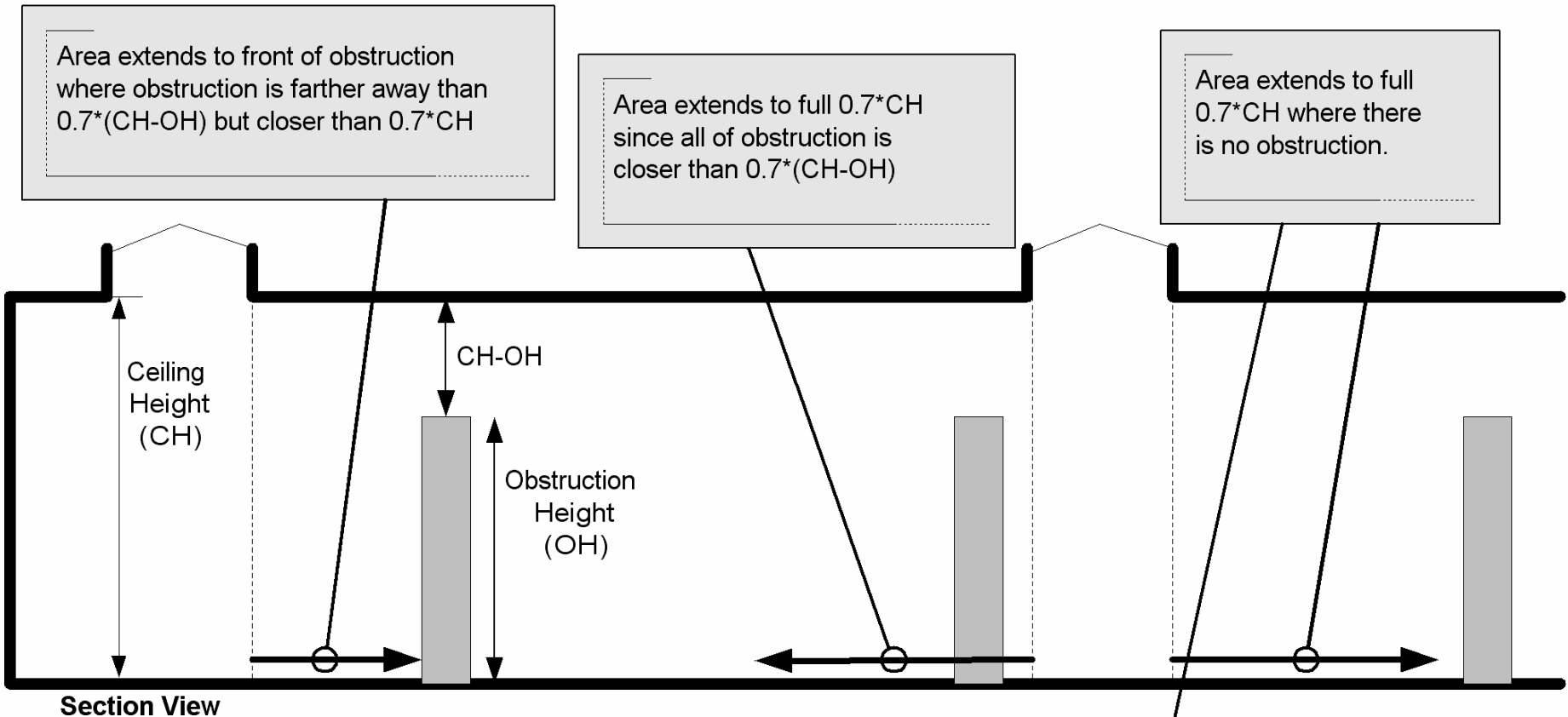
[Addenda “d” and “ab” to 90.1-2007 – Completed review]

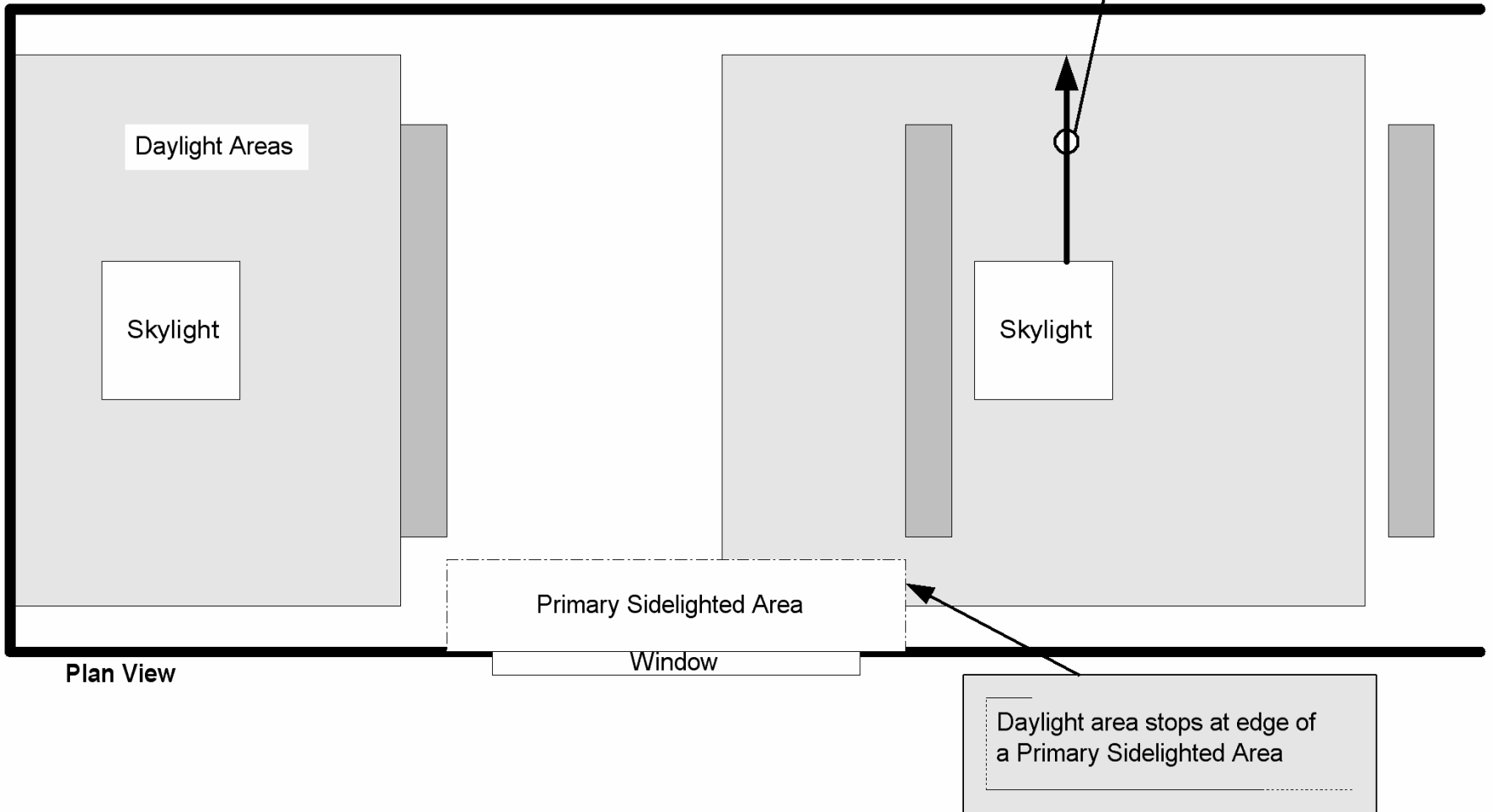
“Daylight Area Under Skylights”

The daylight area under skylights is the combined daylight area under each skylight without double counting overlapping areas.

- ▶ The basic area under each skylight is the skylight opening plus horizontally in each direction, 70% of the ceiling height (CH)
- ▶ These areas are reduced by:
 - The presence of any “primary sidelighted area”,
 - Areas under rooftop monitors, or
 - The distance to the front face of any vertical obstruction depending on location and height (OH).

“Daylight Area Under Skylights”





“Daylight Area Under Skylights”

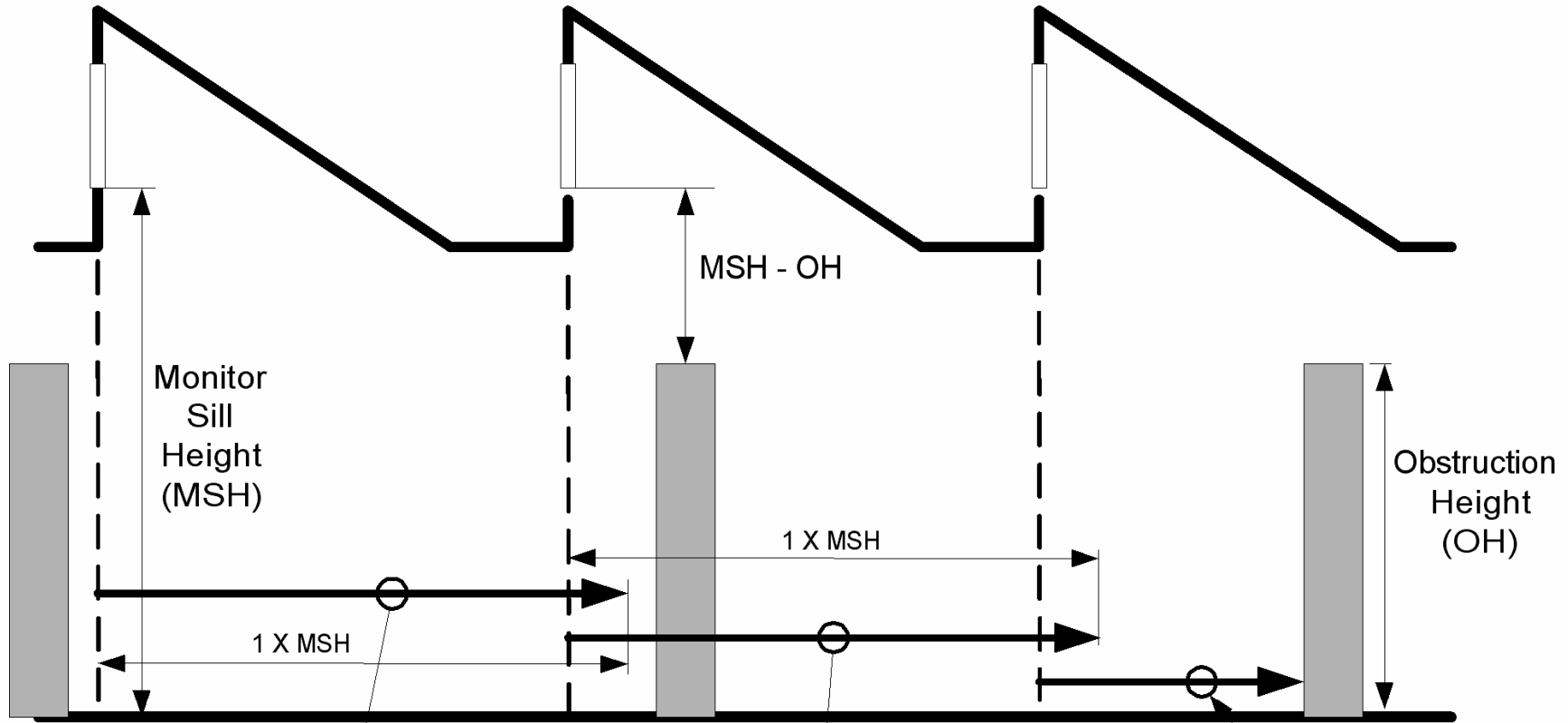
“Daylight Area Under Rooftop Monitors”

Under rooftop monitors: the daylight area under rooftop monitors is the combined daylight area under each rooftop monitor without double counting overlapping areas.

- ▶ The basic area under each monitor is the width of the vertical glazing times the the monitor sill height (MSH, floor to the bottom of monitor), or
- ▶ These areas are reduced by:
 - The presence of any “primary sidelighted area”, or
 - The distance to the front face of any vertical obstruction that is farther away than the difference between the obstruction height (OH) and the monitor sill height

“Daylight Area Under Rooftop Monitors”

Section View

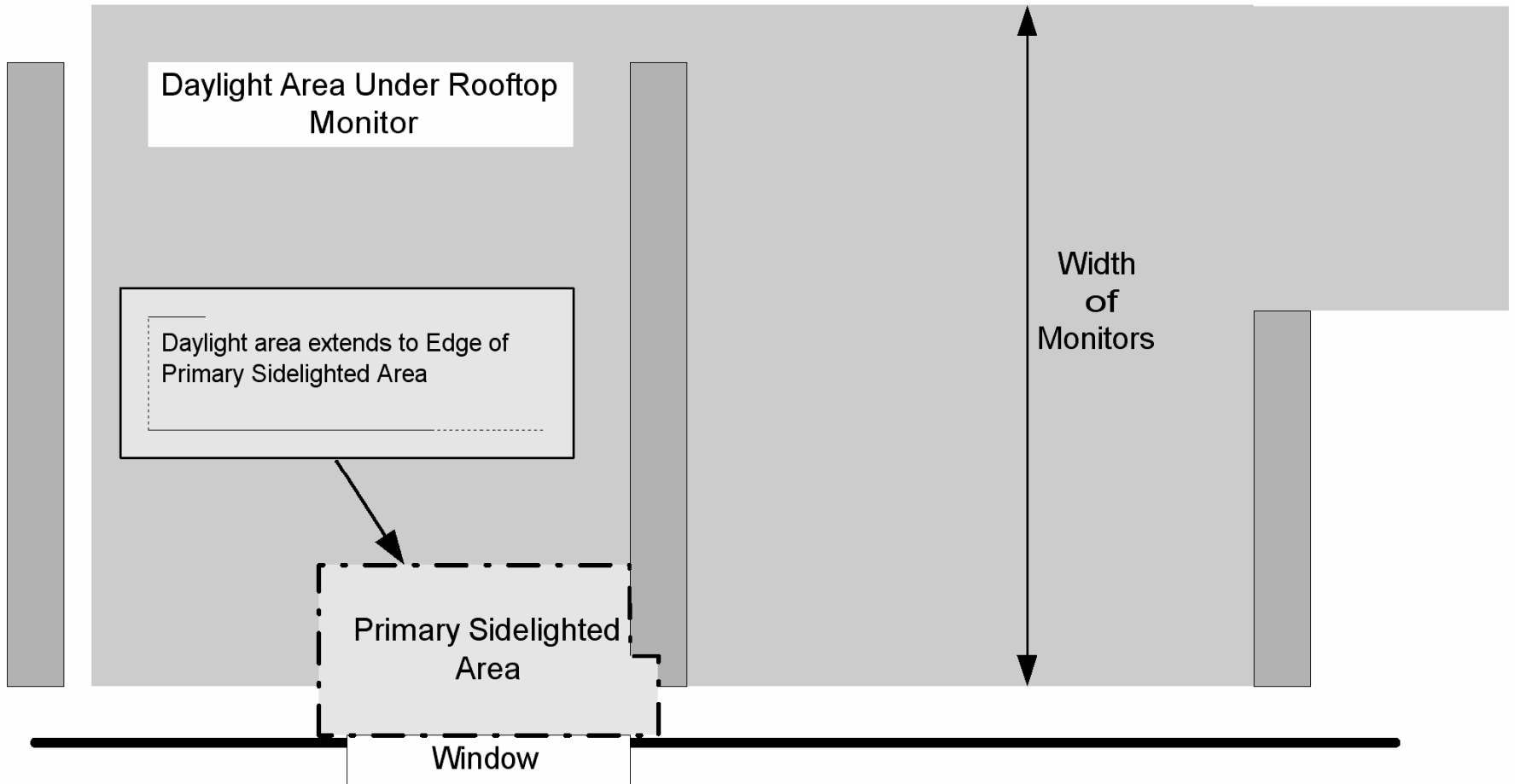


Daylight area extends out to full distance of MSH since there is no obstruction closer than MSH

Daylight area extends out to full distance of MSH since all of obstruction is closer than MSH-OH

Part of daylight area extends only out to the front of obstruction since for that part of the monitor the obstruction is closer than MSH but farther than MSH-OH

Plan View



“Daylight Area Under Rooftop Monitors”

Lighting Control for Toplighting...Exceptions

The following are exempted from this requirement:

- ▶ Areas where direct beam sunlight is blocked by existing adjacent structures or natural objects for more than 1,500 daytime hours per year between 8 am and 4 pm.
- ▶ Areas where the “skylight effective aperture” (EA) of glazing is less than 0.006 (0.6%).
- ▶ Buildings in climate zone 8 with daylight areas totaling less than 8000 ft² in an enclosed space

“Skylight Effective Aperture”

Skylight Effective Aperture is the overall amount of visible light transmittance of the roof via skylights:

$$\text{Skylight Effective Aperture} = \frac{0.85 \times \text{Skylight Area} \times \text{Skylight VLT} \times \text{WF}}{\text{Daylight area under skylights}}$$

Where,

Skylight area = total *fenestration area* of skylights

Skylight VLT = Area weighted average visible light transmittance of skylights as determined in accordance with Section 5.8.2.6

WF = Area weighted average well factor, where well factor is 0.9 if light well depth is less than 2 ft, or 0.7 if light well depth is 2 ft, or greater. Light well depth is measured vertically from the underside of the lowest point on the skylight glazing to the ceiling plane under the skylight.

Lighting Control for Sidelighting

Requires control of electric lighting when sidelighting daylight is available in appropriate areas

- ▶ Applied based on “primary sidelighted area” exceeding 1000 ft².
 - ▶ Control is required for the general lighting over these areas
 - ▶ Control must be multi-level photocontrol
 - At least two output levels at 0% - 35% and 50% - 70%
- OR
- Continuous dimming

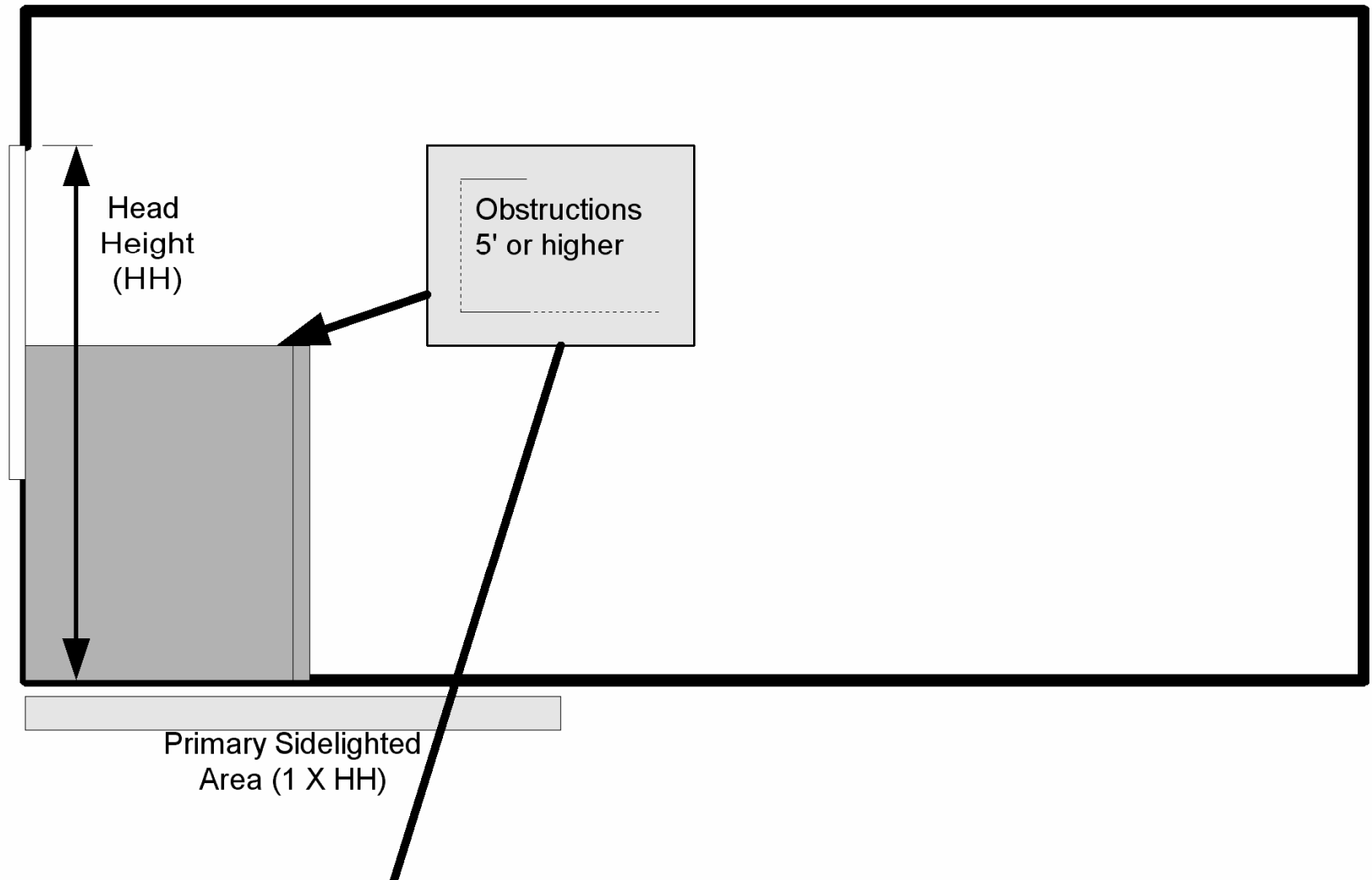
“Primary Sidelighted Area”

Primary sidelighted area is the combined primary sidelighted area without double counting overlapping areas.

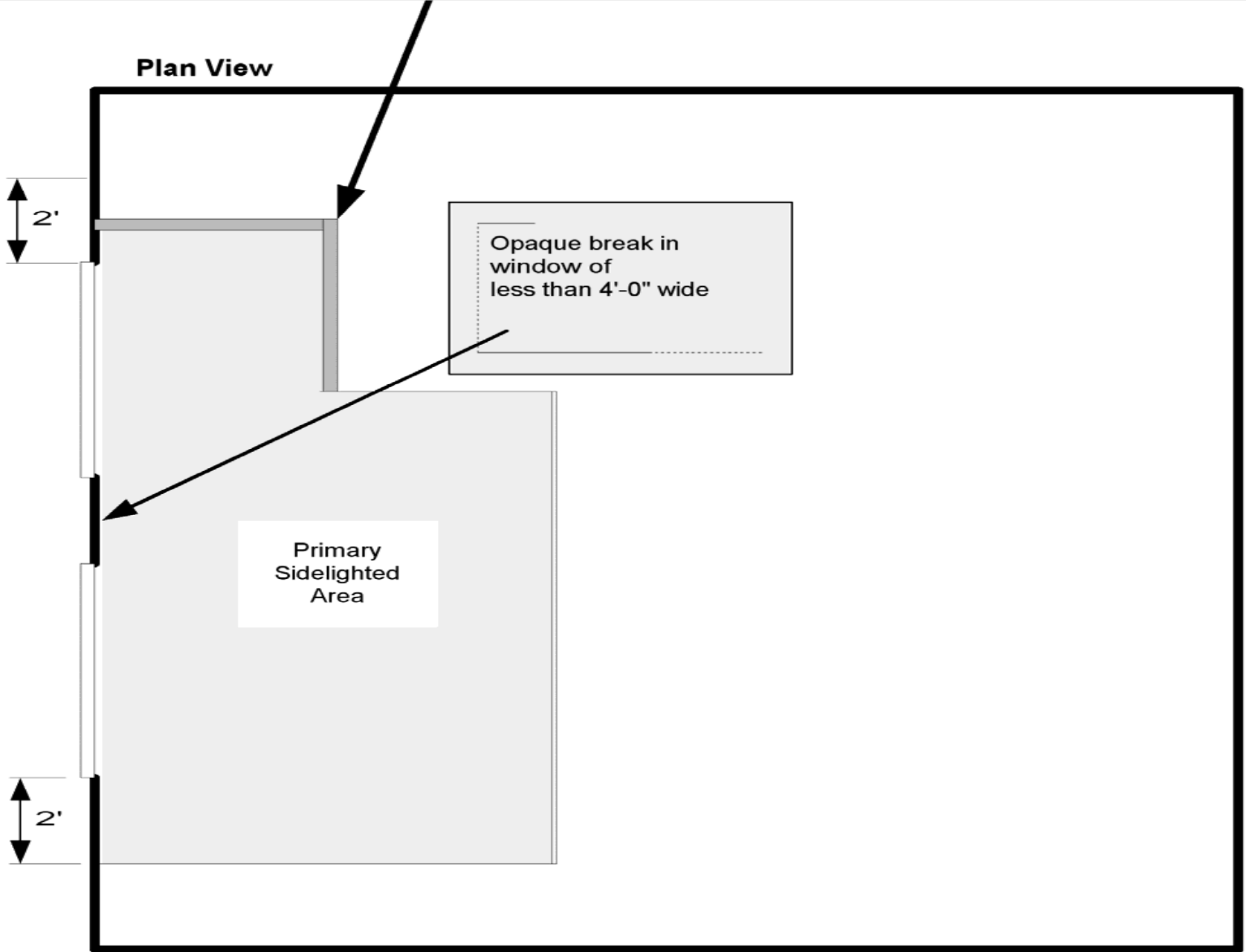
- ▶ The basic sidelighted area is the sidelighted area width times the sidelighted area depth.
- ▶ The sidelighted area width is the width of the window plus, on each side, the smallest of:
 - 2 ft, or
 - the distance to any 5-foot or higher vertical obstruction.
- ▶ The sidelighted area depth is the smaller of:
 - one window head height (floor to the top of the glazing), or
 - the distance to any 5-foot or higher vertical obstruction.

“Primary Sidelighted Area”

Section View



Plan View



“Primary Sidelighted Area”

Lighting Control for Sidelighting...Exceptions

The following are exempted from this requirement:

- ▶ Areas where the top of existing adjacent structures are twice as high above the windows as their distance away from the windows.
- ▶ Areas where the “sidelighting effective aperture” is less than 0.1 (10%).
- ▶ Retail spaces

“Sidelighting Effective Aperture”

Sidelighting Effective Aperture is the relationship of daylight transmitted through windows to the primary sidelighted areas:

$$\textit{Sidelighting Effective Aperture} = \frac{\sum \textit{Window Area} \times \textit{Window VLT}}{\textit{Area of Primary Sidelighted Area}}$$

Where,

Window VLT, is the visible light transmittance of windows as determined in accordance with Section 5.8.2.6

Required Skylight Design and Installation

Requires installation of skylights where appropriate

- ▶ Placed in the Envelope section
- ▶ Retains the existing max 5% skylight-to-roof area limit
- ▶ Applied based on calculated “daylight area under skylights”
- ▶ The “daylight area...” used for compliance must be at least 50% of enclosed area
- ▶ Requirement for each enclosed space (two options):
 - Total area of Installed skylights must be at least 3% of the “daylight area...” with VLT of at least 0.40 - OR -
 - The calculated “skylight effective aperture” in the space must be at least 1%.

[Addendum “a1” to 90.1-2007 – In review]

Required Skylights ... Exceptions

The following are exempted from this requirement:

- ▶ Enclosed spaces in climate zones 6 through 8,
- ▶ Enclosed spaces with designed general lighting power densities less than 0.5 W/ft²
- ▶ Areas where direct beam sunlight is blocked for at least half the roof area over an enclosed area by existing adjacent structures or natural objects for more than 1,500 daytime hours per year between 8 am and 4 pm.
- ▶ Areas where the daylight area under rooftop monitors is greater than 50% of the enclosed space floor area.

Other Potential Proposals for 90.1-2010

All very preliminary and in the consideration, data collection phase by the subcommittee

- ▶ Interior LPD revision
 - Would be based on lighting technical advancements
- ▶ New space/Bldg types
 - Always looking to increase the lists for better application
- ▶ Commissioning
- ▶ Ceiling height adjustment factor
 - Being considered for unusual space geometries
- ▶ Additional power allowance revision
 - Being considered based on possible favorable economics of technologies

A few words about interpretations

Several options:

- ▶ Ask ASHRAE (www.ashrae.org) for an **official** interpretation
 - Considered the same as the written standard and published by ASHRAE
 - Response timeframe: Typically multiple months
- ▶ Ask ASHRAE (www.ashrae.org) for an **unofficial** interpretation
 - Considered an opinion from development staff – not published
 - Response timeframe: Typically days to weeks
- ▶ Email question to www.energycodes.gov
 - Not a formal interpretation but knowledgeable on the Intent, Compliance, and appropriate application
 - Response timeframe: Typically 24-48 hours
- ▶ State building department staff
 - Especially for State specific codes and amendments (MN, FL, WA, etc.)
 - Listing of State building contacts at “Status of State Codes” webpage on www.energycodes.gov

Questions? Comments? Issues?

Your input is very valuable to the Standards/Codes development process