

March 23rd, 2015

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Re: Docket # 15-BSTD-01

**Individual Area Controls for Luminaires Controlled by Automatic Daylighting
 Controls in Separate Daylit Zones are not Overtly Required by the Current Code
 Documents**

INTRODUCTION:

The 2013 Building Energy Efficiency Standards and the 2013 Reference Appendices require that Mandatory Automatic Daylighting Controls undergo Acceptance Testing by Certified Field Technicians. The requirement that luminaires and their associated Automatic Daylighting Controls in separate daylit zones must be tested separately is consistent throughout the 2013 Reference Appendices, 2013 Nonresidential Compliance Manual, and the current Acceptance Testing Form: NRCA-LTI-03-A.

Example:

NA7.6.1 ~~Acceptance tests for Automatic Daylighting Controls~~ Acceptance tests
~~complying with Section 130.1(d)~~

NA 7.6.1.2 Functional testing

For each photocontrol to be tested do the following:

(a) Test each group of lights controlled separately by the photocontrol according to the following protocol. In all interior spaces other than parking garages, a separate test shall be conducted for daylighting control of the primary sidelit zone separate from the secondary sidelit zone.

Additionally NRCA-LTI-03-A Requires Differing Daylit Zone Types to be listed individually for testing:

Control System	System Name	Plans Page Number	Check if Tested Control is Representative of Sample	Applicable Control System		
A	B	C	<input type="checkbox"/>	A	B	C
			<input type="checkbox"/>			
			<input type="checkbox"/>			
			<input type="checkbox"/>			
2 System Information						
Zone Type: Skylit (Sky), Primary Sidelit (PS), or Secondary Sidelit (SS)						
Control Type: Continuous Dimming with more than 10 light levels (C), Stepped Dimming (SD), Switching (SW)						
Design Footcandles: (enter number or "Unknown")						

This requirement is echoed in the 2013 Nonresidential Compliance Manual:

13.88 NA7.6.1 Automatic Daylighting Control Acceptance

At-A-Glance

Automatic Daylighting Control Acceptance Use Form NRCA-LTI-03-A

Purpose of the Test

Acceptance Criteria

How to Conduct the Test and Fill the Form

If more than one type of Daylit Zone and thus daylighting control systems exist on site, these should be clearly marked on the plans, and also noted on the Form. The Form allows the user to specify up to three (3) systems per Form.

For buildings with several daylighting controls, it is allowable to sample the controls for Acceptance Testing. If this is the case, it should be clearly noted on the forms. A separate sheet should be attached to the Form with names of the other controls and systems that are being represented by the three systems on the Form. At least one daylighting control shall be tested for each Daylit Zone category (Skylit, Primary Sidelit, and Secondary Sidelit).

Therefor – the requirement to conduct testing on a luminaire, (or a group of luminaires), controlled by Automatic Daylighting Controls in each “Daylit Zone category” *Individually* and apart from other lighting in an area is unquestionable.

ABSTRACT:

The author wishes to impart that the lack of a clear requirement to provide the ability to individually energize the controlled lighting in separate daylit zone types may often cause this Acceptance Testing Requirement to become impractical – possibly unfeasible.

The commissioning of lighting in an area containing daylit areas, and hence automatic daylighting controllers, and the acceptance testing of same; are two different things entirely. The lighting commissioning agent must insure a reasonably uniform level of illumination throughout the entire area; the field technician need only perform acceptance testing on each daylit zone’s lighting individually.

The complications that will arise from being unable to energize lighting only in the daylit area under testing can be staggering – (the author of this document has personal experience with this). The intrusion of illumination from adjacent daylit zones and other general lighting can render the collection of test data using a light meter impossible. Only “masking” out this unwanted illumination with extensive curtains and similar items can remove the objectionable interference. Attempting to perform a “power measurement” analysis under these circumstances is even more problematic.

DISCUSSION (Part One):

If the reader is already convinced that separate *Area* Controls should be mandated for differing daylight zones in an area, then please skip to the end of this document for suggested changes to the Code language. If the reader is unconvinced – (or believes these Area Controls are already stipulated) – then read on ...

Let's examine the goals of functional testing of Automatic Daylighting Systems by a Field Technician:

- 1) To determine if Power Reduction requirements are met;
- 2) To determine if the system is "tracking" properly;
- 3) To determine if lighting controls are functioning properly.

The last goal is accomplished simply by observing the behavior of luminaires in the area containing daylight areas.

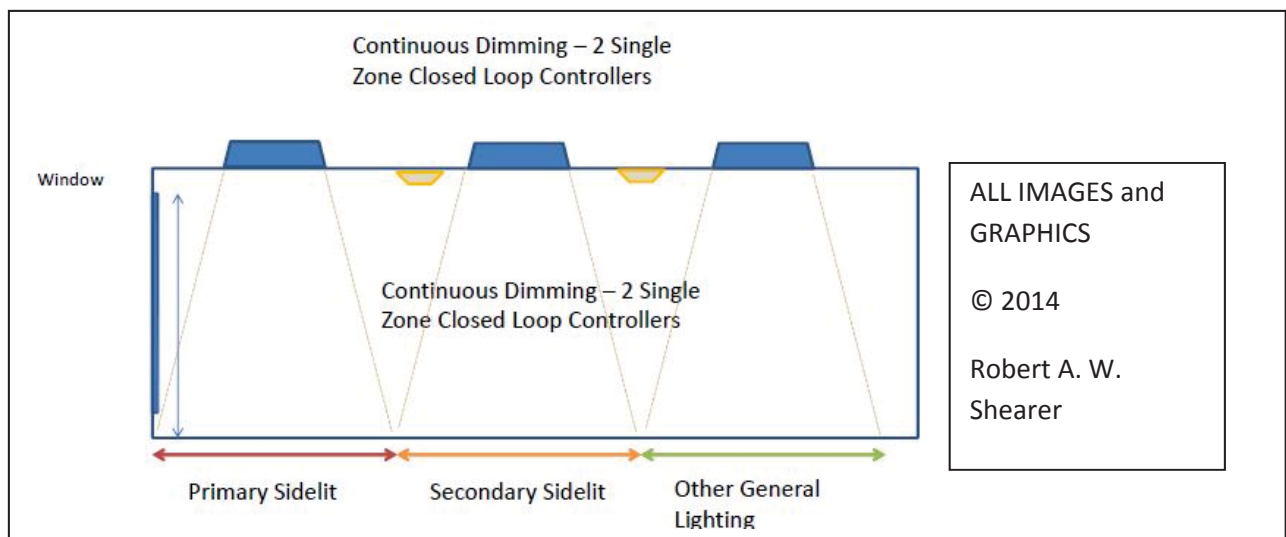
The second goal is determined by a combined illumination reading taken at a point or points during system operation: This is easily interfered with by surrounding luminaires.

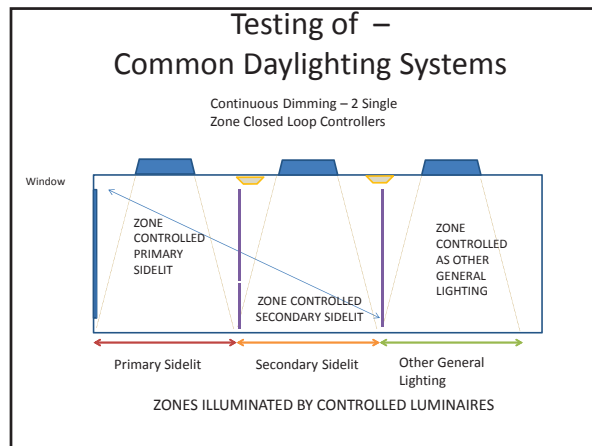
It is the first goal which will be rendered difficult – (if not impossible) – to verify without separate Area Controls for luminaires in daylight areas.

Remember:

The Field Technician must measure illumination reduction, (or "power" reduction), to determine power reduction in a single daylight area. The Field Technician must determine *combined* illumination in a single daylight area to accomplish the second goal.

Let's look at an area with both Primary Sidelit and Secondary Sidelit daylight areas:



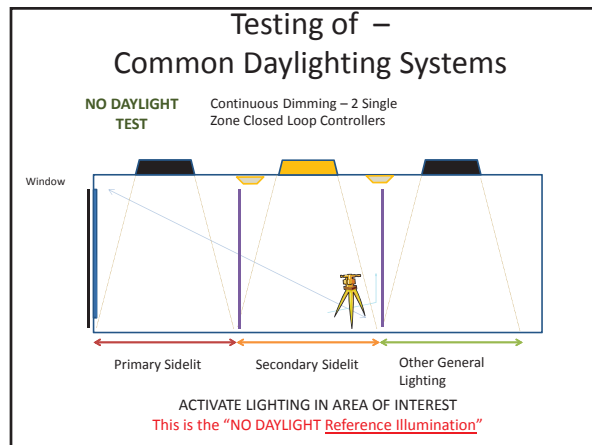


INSTRUCTOR COMMENTS

Let's test the Secondary Sidelit Zone

With the ability to "turn it on" separately from other lighting in the area of interest

...

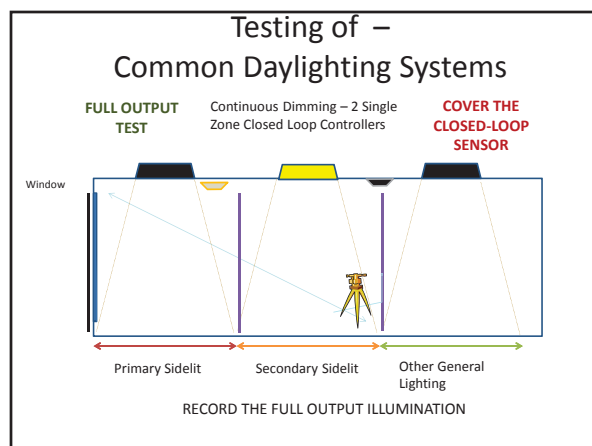


INSTRUCTOR COMMENTS

NOW: WE TURN A DAYLIGHT CONTROLLED STAGE ON AND LET THE LIGHTS SETTLE OUT ...

... AND TAKE AN ILLUMINANCE READING AT THE "REFERENCE LOCATION"

We read 16 fc

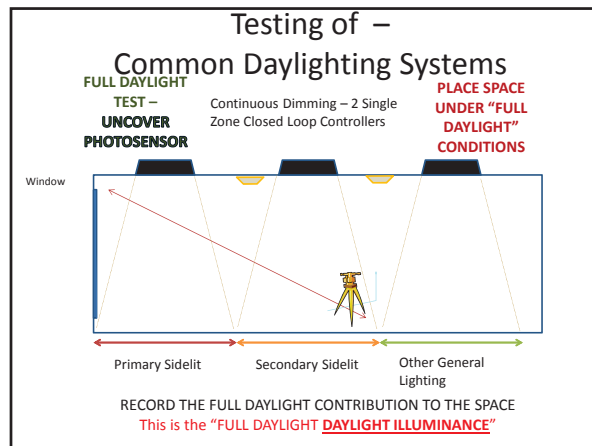


INSTRUCTOR COMMENTS

FOR A *CONTINUOUSLY DIMMED* SYSTEM WE ALSO WANT TO KNOW HOW HIGH THE ELECTRIC ILLUMINANCE CAN GO ...

THE ACCEPTANCE FORM WANTS US TO CHECK THIS - BECAUSE WE ARE GOING TO CALCULATE OUR POWER REDUCTION FROM: "FULL OUTPUT"

... SO, COVER THE SENSOR, WAIT FOR THE LIGHTING TO STABILIZE, AND RECORD THE ILLUMINANCE AT THE "REFERENCE LOCATION" We read 20 fc

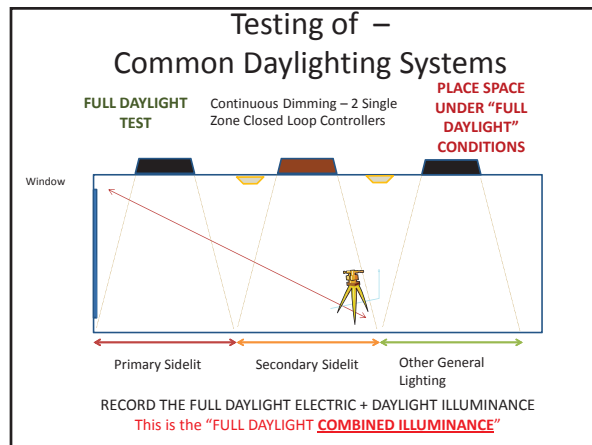


INSTRUCTOR COMMENTS

NOW WE ARE AFTER THE LEVEL OF *ELECTRIC* ILLUMINATION UNDER “FULL DAYLIGHT” CONDITIONS.

WE ARE GOING TO USE THIS TO DETERMINE THE POWER REDUCTION FROM “NO DAYLIGHT”/“FULL OUTPUT” TO “FULL DAYLIGHT” CONDITIONS.

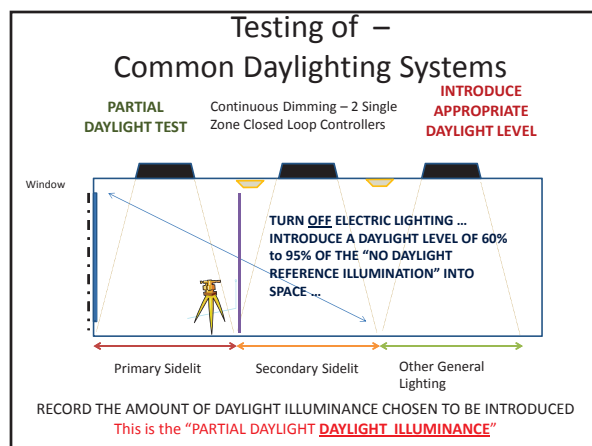
We let 20 fc into the space



INSTRUCTOR COMMENTS

TURN THE *ELECTRIC* LIGHTING BACK ON
We read: 24 fc - NOW WE NEED TO KNOW HOW MUCH *ELECTRIC* ILLUMINATION WE HAVE UNDER THIS CONDITION.

SO ... MAKE SURE YOU KNOW HOW MUCH DAYLIGHT YOU'RE LETTING IN (20fc)
ANY ADDITIONAL ILLUMINATION YOU SEE NOW IS FROM THE *ELECTRIC* LIGHTS: THIS IS THE “NO DAYLIGHT” *ELECTRIC* ILLUMINANCE. 4 fc



INSTRUCTOR COMMENTS

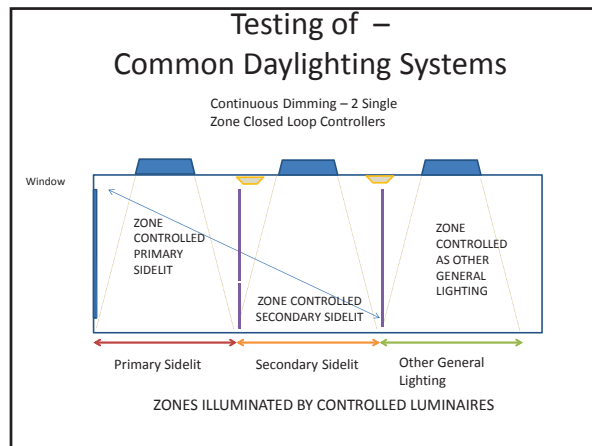
We'll skip the “Partial Daylight” test ...

Our Illumination Reduction from:

20 fc “Full Output” to,

4 fc “No Daylight *ELECTRIC*” gives us an Illumination reduction of 80% for an Estimated Power reduction of ~ 70%

Not the best system in the world - but it passes.

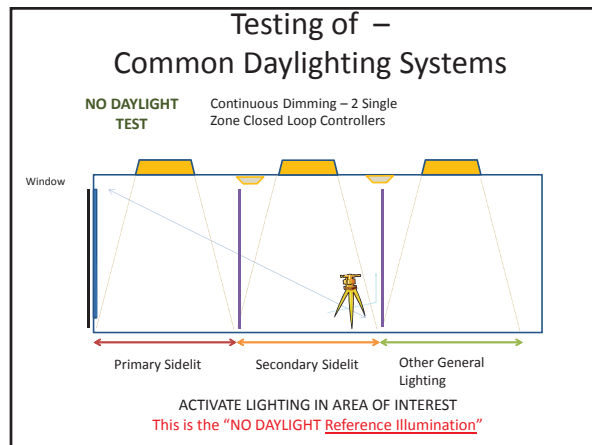


INSTRUCTOR COMMENTS

Let's test the Secondary Sidelit Zone:

But Now:

We can't shut off the other lighting in the area!

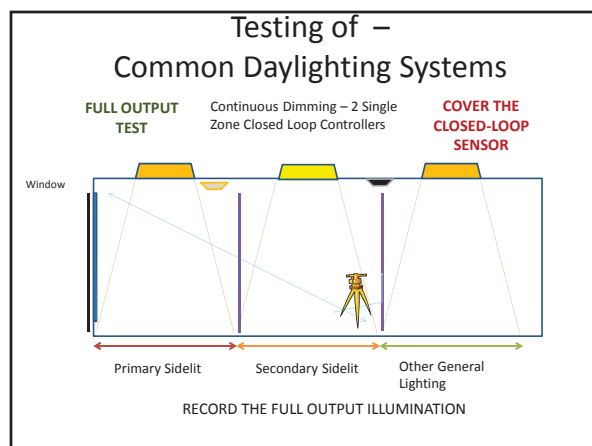


INSTRUCTOR COMMENTS

NOW: WE TURN ON THE LIGHTING IN THE *ENTIRE AREA* AND LET THE LIGHTS SETTLE OUT ...

... AND TAKE AN ILLUMINANCE READING AT THE "REFERENCE LOCATION"

We read 40 fc

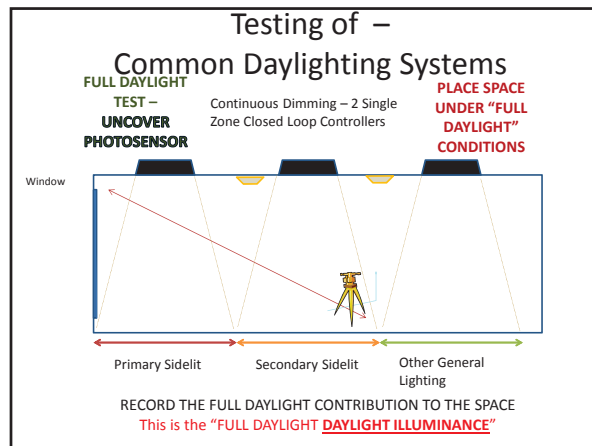


INSTRUCTOR COMMENTS

FOR A *CONTINUOUSLY DIMMED* SYSTEM WE ALSO WANT TO KNOW HOW HIGH THE ELECTRIC ILLUMINANCE CAN GO ...

THE ACCEPTANCE FORM WANTS US TO CHECK THIS - BECAUSE WE ARE GOING TO CALCULATE OUR POWER REDUCTION FROM: "FULL OUTPUT"

... SO, COVER THE SENSOR, WAIT FOR THE LIGHTING TO STABILIZE, AND RECORD THE ILLUMINANCE AT THE "REFERENCE LOCATION" We read 44 fc



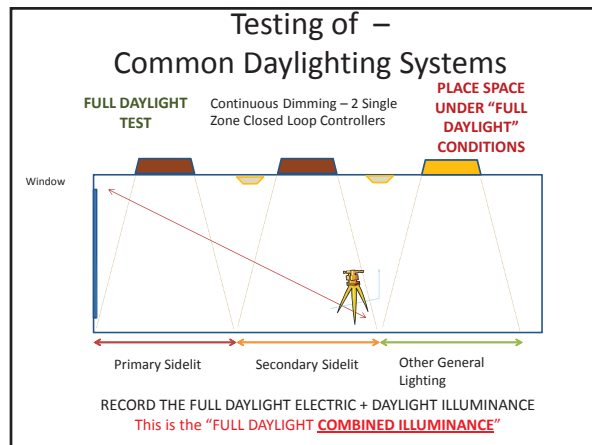
INSTRUCTOR COMMENTS

NOW WE ARE AFTER THE LEVEL OF *ELECTRIC* ILLUMINATION UNDER “FULL DAYLIGHT” CONDITIONS.

WE ARE GOING TO USE THIS TO DETERMINE THE POWER REDUCTION FROM “NO DAYLIGHT”/“FULL OUTPUT” TO “FULL DAYLIGHT” CONDITIONS.

We let 50 fc into the space -

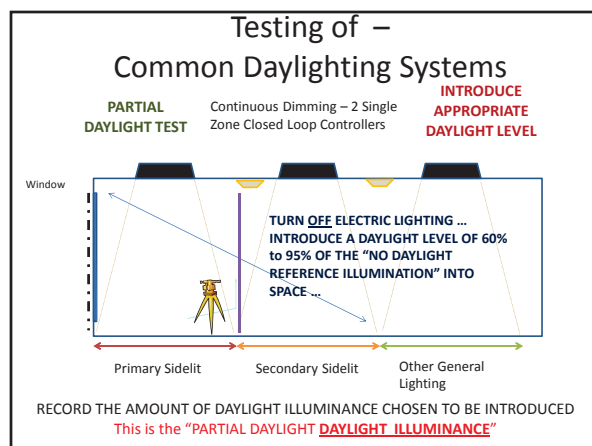
NOTE: the higher this requirement the more difficult the testing process is ...



INSTRUCTOR COMMENTS

TURN THE *ELECTRIC* LIGHTING BACK ON
We read: 75 fc - NOW WE NEED TO KNOW HOW MUCH *ELECTRIC* ILLUMINATION WE HAVE UNDER THIS CONDITION.

SO ... MAKE SURE YOU KNOW HOW MUCH DAYLIGHT YOU'RE LETTING IN (50fc)
ANY ADDITIONAL ILLUMINATION YOU SEE NOW IS FROM THE *ELECTRIC* LIGHTS: THIS IS THE “NO DAYLIGHT” *ELECTRIC* ILLUMINANCE. 25 fc



INSTRUCTOR COMMENTS

We'll skip the “Partial Daylight test

Our Illumination Reduction from:

44 fc “Full Output” to,

25 fc “No Daylight *Electric*” gives us an Illumination reduction of 43% for an Estimated Power reduction of ~ 39%

THIS IS THE SAME SYSTEM!
BUT NOW IT FAILS MISERABLY!

What the Lighting Controls Acceptance Test Technician did not know, (and could not know), is that the Primary Sidelit Zone luminaires provided 1 to 4 fc illumination at the Secondary Sidelit Reference Location – and that the Other General Lighting provided 20 fc at the Secondary Sidelit Reference Location. (In the author’s experience; these are realistic numbers.)

So ... how much illumination reduction is from the Primary Sidelit Zone? And ... how much additional illumination is provided by the other general lighting? Current draw analysis is, perhaps, even more complex under these conditions.

To say that this complicates the analysis is an understatement. As well as fouling up the Field Technicians readings, he or she will now be forced to introduce a much higher level of “daylight” into the area under test. This introduces an additional complication.

What about taking a current reading? Well ... if a Field Technician can’t segregate the field wiring in the area to isolate the daylight zone luminaires under test, then she or he will have to make an algebraic estimate of the current still drawn by the other general lighting in the area. And, what of the power reduction caused by other daylight zones luminaires? Perhaps the Field Technician can read the current into one luminaire of a group in a daylight zone; this will probably be wildly inaccurate: (please see: “Proposed Revisions to 2016 NA7.6.3 Demand Responsive Controls Acceptance Tests.” by Richard N. Miller, PE.): submitted to Docket # 15-BSTD-01.

DISCUSSION (Part Two):

Are the requested *Area* Controls already stipulated?

If they are, the author cannot find them. The requirement for separate “controls” for separate daylight zones appear numerous times within the Code documents; but, the requirement for separate *Area* Controls for differing daylight zones cannot be found.

We will begin by examining the 2013 Building Energy Efficiency Standards section 130.1 (a) and proceed from there.

SECTION 130.1 – INDOOR LIGHTING CONTROLS THAT SHALL BE INSTALLED

(a) Area Controls.

4. **Separately Controlled Lighting Systems.** In addition to the requirements in Section 130.1(a)1, 2, and 3:
 - A. General lighting shall be separately controlled from all other lighting systems in an area.

This *infers* that General lighting shall be controlled separately from other lighting control *systems* in an area; but does not state what we want.

(d) **Automatic Daylighting Controls.**

2. Luminaires providing general lighting that are in or are partially in the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable requirements of Section 110.9, and the applicable requirements below:

B. Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.

Still no mention of: *Area Controls*.

SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

(d) **Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone as defined in Section 130.1(d)1C, and that is not in a Primary Sidelit Daylit Zone shall:

1. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9;

Nope – no Area Controls here...

The following sections of the 2013 Nonresidential Compliance Manual, while specifying separate “controls”, do not specifically mention *Area Controls*:

5.4.4 Mandatory Automatic Daylighting Controls

If code compliance is accomplished with the prescriptive approach then daylighting controls will be required in both the primary and secondary sidelit zones and these two zones must be controlled separately from each other.

C. Controlling Lighting in Daylit Zones

2. Mandatory daylighting controls are required in the following daylit zones:

Luminaires providing general lighting that are in, or at least 50% in, the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable device requirements in §110.9, and meet the applicable requirements below:

a. All Skylit Daylit Zones and Primary Sidelit Daylit Zones shall be shown on the building plans.

b. Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.

c. Luminaires that fall in both a Skylit and Primary Sidelit Daylit Zone shall be controlled as part of the Skylit Daylit Zone.

And ...

13.88 NA7.6.1 Automatic Daylighting Control Acceptance

At-A-Glance

Automatic Daylighting Control Acceptance Use Form NRCA-LTI-03-A

Purpose of the Test

Acceptance Criteria

Lighting is correctly circuited so that general lighting fixtures in the Daylit Zone are on the automatic daylighting controlled circuit and lighting outside of the Daylit Zone is not on the controlled circuit. [§130.1(d)2A]

And ...

Potential Issues and Cautions

Check fixture circuiting while access to wiring is relatively easy (i.e. while lift is available or before obstructions are installed).

And ...

Construction Inspection

How to Conduct the Test and Fill the Form

Step 2: System Information

Contains:

When automatic daylighting controls are required in Primary Sidelit Daylit Zones, these lights must be separately controlled from the Secondary Sidelit Daylit Zone.

And ...

Controls for Sidelit Daylit Zones are required to be separate from controls for Skylit Daylit Zones.

And ...

Construction Inspection

Purpose of the Test

Criteria for Passing the Test

Daylighting controls only control those luminaires that are in the daylighted area for which they are intended and luminaires in Sidelit Daylit Zones are controlled separately from luminaires in Skylit Daylit Zones.

Step 5: Daylit Zone Circuiting

Verify that the luminaires in the Daylit Zone are controlled separately from those outside the Daylit Zone. Further, verify that the luminaires in daylighted areas near windows are circuited separately from the luminaires in daylighted areas under skylights.

And ...

Zone Illuminated by Controlled Luminaires

The Sidelit and Skylit Daylit Zones define which luminaires must be controlled. Luminaires in the Sidelit or Skylit Daylit Zones must be controlled by automatic daylighting controls, and luminaires outside of these areas must not be controlled by the same automatic daylighting control.

And ...

Continuous Dimming Control Systems – Functional Performance Test

Step 2: 'No Daylight' Test

If you cannot eliminate all daylight from the area or other electric light from other luminaires: Turn the controlled lighting on and off. The difference in light level will be the contribution of the controlled lighting.

Primary Sidelit Daylit Zones have to be separately controlled from Secondary Sidelit Daylit Zones, and vice versa. They may use a single sensor for implementation, but the control response formulas must be distinct.

Sidelit Daylit Zones have to be separately controlled from Skylit Daylit Zones.

And ...

Step 3: Full daylight test.

Primary Sidelit Daylit Zones have to be separately controlled from Secondary Sidelit Daylit Zones, and vice versa. They may use a single sensor for implementation, but the control response formulas must be distinct.

- Sidelit Daylit Zones have to be separately controlled from Skylit Daylit Zones.

The daylighting control assigned to a specific Daylit Zone shall not control fixtures beyond the Zone, with the exception of Primary and Secondary Sidelit Daylit Zones in which both share a boundary.

And ...

Stepped Switching or Stepped Dimming Control Systems Functional Performance Test

How to Conduct the Test and Fill the Form

Step 3: Full Daylight Test

Only luminaires in Daylit Zones (Skylit Daylit Zone, Primary Sidelit Daylit Zone and Secondary Sidelit Daylit Zone) are affected by daylight control.

And ...

5.5.1 Prescriptive Daylighting Control Requirements

A. Automatic Daylighting Controls in Secondary Daylit Zones.

1. The general lighting shall be controlled independently from all other luminaires (including those in the primary sidelit zone, the daylit zone under skylights and lights that are not in daylit zones) by automatic daylighting controls that meet the applicable requirements of §110.9;

Discussion (Part Three):

Well ... None of these passages include separate ON/OFF Controls for these individual daylit zones. Remarks about the luminaires being separately “circuited” is unclear.

So ... Can we find anything that even *INFERS* that daylit zone controlled luminaires should be considered as a different lighting *Function* in an area? I believe we can.

How about the very *Definition* of General Lighting?

5.4.4 Mandatory Automatic Daylighting Controls

A. Description of Terms

The following terms are used to describe the daylighting requirements in §130.1(d).

1. General Lighting

Electric lighting that provides a uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect, exclusive of daylighting, and also known as ambient light. Thus general lighting does not include display lighting (which is typically directional lighting such as seen in MR, and PAR, spot or flood lamps) or “wall washers” (luminaires with an asymmetric distribution for illuminating vertical surfaces). General lighting is also not ornamental lighting as seen in drum fixtures, chandeliers or projection lighting. General lighting typically makes use of troffers (prismatic and parabolic and indirect diffusers), pendant lighting (direct, indirect or direct/indirect), high bay fixtures, low bay fixtures and “aisle-lighter” fixtures.

No Help here ... Except: “exclusive of daylighting”.

And ...

13.88 NA7.6.1 Automatic Daylighting Control Acceptance

General lighting is defined as lighting that is “designed to provide a substantially uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect.” Linear fluorescent troffers and pendants, high and low bay luminaires and other non-directional light sources are considered general lighting.

Really?

Section 100.1 of the “BEES” defines GENERAL LIGHTING as:

General Lighting is installed electric lighting that provides a uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect, exclusive of daylighting, and also known as ambient lighting.

Please note the clause: “exclusive of daylighting”. Unfortunately the author cannot find a definition of “daylighting” in Section 100.1 – so ... this could mean: 1) Actual natural daylight or 2) General lighting luminaires under control of Automatic Daylighting Controls. The author of this document would *obviously* prefer the latter definition.

CONCLUSION:

It is a bad year to be a Lighting Designer in the State of California. Fortunately, the author is not one. To amend the code language to allow Lighting Controls Acceptance Test Technicians to accomplish their work in a repeatable, verifiable, and consistent manner: the following amendments to Code language are suggested:

Discussion (Part Four):

Can minor changes to code language stipulate these Area Control requirements?

In other words: Can we signify the luminaires under automatic daylighting controls are a different lighting *function* in an area?

Well ... within the “General Lighting” definition: changing the term “daylighting” to “luminaires providing illumination in daylit zones”, or “luminaires controlled by automatic daylighting controls”, will create a “circular” definition – a tautology – as the controlled lighting in the daylit zone *is* General Lighting. This is not “good logic”. Also: defining “daylighting” as such in 100.1 will produce the same quandary.

So we’ll have to leave the General Lighting definition alone.

This brings us to: The Building Energy Efficiency Standards Sections 130.1 (a), (d), and 140.6 (d).

Let’s examine 130.1 (a) 3. **Other Lighting Controls:**

A. Other lighting controls may be installed in addition to the manual lighting controls provided they do not override the functionality of controls installed in accordance with Section 130.1(a)1, 2, or 4.

130.1 (a) 1 and 2 are moot points: let’s examine 4.

4. Separately Controlled Lighting Systems. In addition to the requirements in Section 130.1(a)1, 2, and 3:

A. General lighting shall be separately controlled from all other lighting systems in an area.

B. Floor and wall display, window display, case display, ornamental, and special effects lighting shall each be separately controlled on circuits that are 20 amps or less.

C. When track lighting is used, general, display, ornamental, and special effects lighting shall each be separately controlled.

Ok ... here’s where we put it in ...

We can’t put the Area Controls stipulation for separate daylit zones in B. because it limits the lighting branch circuit(s) to 20 amps or less. As this is nonresidential, and, (without further research on my part): this might not be a proper thing to stipulate for portions of large lighting systems in an area.

For C., track lighting, we can just add:

C. When track lighting is used, general, display, ornamental, ~~and~~ special effects lighting, and general lighting controlled independently by automatic daylighting controls shall each be separately controlled.

And ... that takes care of track lighting heads used for general illumination in a daylit zone.

So ... this leaves us with A. To specify that independently controlled General Lighting in areas is a separate lighting *function*, we might stipulate.

A. General lighting shall be separately controlled from all other lighting systems in an area, including systems controlling general lighting luminaires in separate daylighting zones.

And ... that’s it for Section 130.1 (a)

Suggested modifications to 130.1 (d):

2. Luminaires providing general lighting that are in or are partially in the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable requirements of Section 110.9, and the applicable requirements below:

A. All Skylit Daylit Zones and Primary Sidelit Daylit Zones shall be shown on the plans.

B. Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.

C. Luminaires that fall in both a Skylit and Primary Sidelit Daylit Zone shall be controlled as part of the Skylit Daylit Zone.

Could include the amendment:

2. Luminaires providing general lighting that are in or are partially in the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable requirements of Section 110.9, and shall not override the functionality of other lighting controls required for compliance with Section 130.1 (a), and the applicable requirements below:

Similarly, Section 140.6 (d):

(d) **Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone as defined in Section 130.1(d)1C, and that is not in a Primary Sidelit Daylit Zone shall:

1. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9; and

2. Be controlled in accordance with the applicable requirements in Section 130.1(d)2; and

3. All Secondary Sidelit Daylit Zones shall be shown on the plans submitted to the enforcing agency.

EXCEPTION 1 to Section 140.6(d): Luminaires in Secondary Sidelit Daylit Zone(s) in areas where the total wattage of general lighting is less than 120 Watts.

EXCEPTION 2 to Section 140.6(d): Luminaires in parking garages complying with Section 130.1(d)3.

... could include the change:

2. Be controlled in accordance with the applicable requirements in Section 130.1(d)2, and 130.1(a)4; and

... And, that should get it ...

SUMMARY:

In order to insure the development of a repeatable, verifiable, and “simple” procedure for testing Automatic Daylighting Control Systems for *individual* Daylit Zones, (as required by Code), a Lighting Controls Acceptance Testing Technician Certification Provider must expect that their Field Technicians will encounter Daylit Zones with controlled luminaires capable of being separately energized by Area Controls.

Robert A. Shearer, BSEE