

Second Stakeholder Meeting for **Advanced Daylighting Design**

March 30, 2017

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1. Background

Relevant Code History

- There are no requirements in Title 24, Part 6
 - Lighting power credits given for certain types of lighting controls only.
 - Solar heat gain credit for shading but no daylighting credit
 - Previous envelope/daylighting window and skylight PAFs (ca. 2005)
- Other Relevant Code Requirements
 - No known requirements or daylighting credits

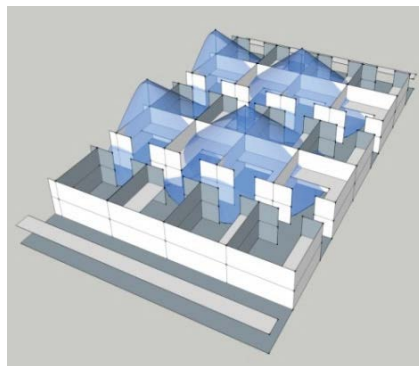
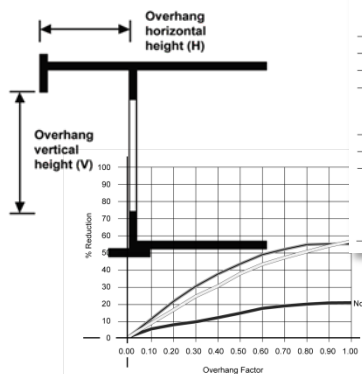


Figure 3-14: Overhang Dimensions



Manual Dimming with Dimmable Electronic Ballasts and Occupant sensor with "manual ON" or automatic ON to less than 50% power and switching

Any space ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room

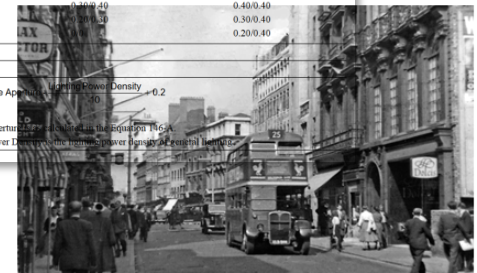
0.25

Automatic Daylighting Controls with Windows (Stepped Switching or Stepped Dimming/Continuous Dimmed)

Window Wall Ratio		
Glazing Type - Windows	< 20%	20% to 40%
VLT $\geq 60\%$	0.20/0.30	0.40/0.40
VLT ≥ 35 and < 60%	0.0	0.30/0.40
VLT < 35%	0.0	0.20/0.40

Automatic Multi-Level Daylighting Controls with Skylights

Glazing Type - Skylights	Factor
Glazing material or diffuser with ASTM D1003 haze measurement greater than 90%	10 \times Effective Aperture
WHERE	
Effective Aperture	Effective Aperture
Lighting Power Density	Lighting Power Density



2. Proposed Code Changes

Proposed Code Change


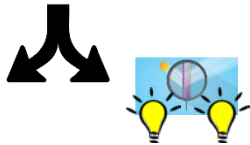
- PAF based on  
 - Orientation, WWR, control type, setpoint, zones controlled
 - Fixed slats: geometry (cutoff, width, spacing)
 - Clerestories: min width/height, relative placement window/ceiling
 - Daylight Redirecting Devices: CEC approved
 - Automated shading, dynamic glazing, etc. 2022

TABLE 140.6-A LIGHTING POWER ADJUSTMENT FACTORS (PAF) CONT'D

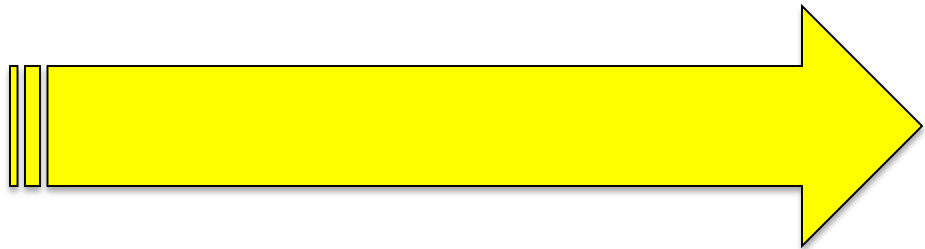
			Control	Multi-level/Dimming											
			Setpoint	100			300			500			1000		
Az	SWWR	CO	Zone(s)	1	2	3	1	2	3	1	2	3	1	2	3
90 - 160	10%	10	1.750 WSR	0.25	0.20	0.15	0.0	-	-	-	-	-	-	-	-
			2.000 WSR	0.25	0.20	0.15	0.0	-	-	-	-	-	-	-	
			2.500 WSR	0.25	0.20	0.15	0.05	-	-	-	-	-	-	-	
			3.500 WSR	0.20	0.10	0.05	-	-	-	-	-	-	-	-	
		20	1.375 WSR	0.20	0.15	0.10	0.0	0.05	-	-	-	-	-	-	-
			1.500 WSR	0.20	0.15	0.10	0.0	0.05	-	-	-	-	-	-	-
			1.750 WSR	0.15	0.15	0.10	0.0	-	-	-	-	-	-	-	-
			2.125 WSR	0.15	0.15	0.10	0.0	-	-	-	-	-	-	-	-
		N/A	CL	0.10	0.10	0.10	0.0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
			DRD	0.10	0.10	0.10	0.0	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	20%	10	1.750 WSR	0.25	0.25	0.20	0.20	0.10	0.05	0.05	-	-	-	-	-
			2.000 WSR	0.25	0.25	0.20	0.15	0.05	0.05	0.05	-	-	-	-	
			2.500 WSR	0.25	0.25	0.20	0.10	0.05	-	-	-	-	-	-	
			3.500 WSR	0.25	0.20	0.15	0.05	-	-	-	-	-	-	-	
			1.375 WSR	0.20	0.20	0.15	0.15	0.10	0.05	0.10	-	-	-	-	
			1.500 WSR	0.20	0.20	0.20	0.15	0.10	0.05	0.10	0.05	-	-	-	
			1.750 WSR	0.20	0.20	0.15	0.15	0.10	0.05	0.10	0.05	-	-	-	
			2.125 WSR	0.20	0.15	0.15	0.15	0.10	0.05	0.05	-	-	-	-	
		N/A	CL	0.10	0.10	0.10	0.10	0.10	0.15	0.10	0.15	0.15	0.15	0.15	0.15
			DRD	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
			20	1.750 WSR	0.25	0.25	0.25	0.20	0.10	0.05	0.10	-	-	-	-
				2.000 WSR	0.25	0.25	0.25	0.20	0.10	0.05	0.10	-	-	-	-

Why Are We Proposing This Code Change

- PAFs may become requirements in future updates (prep for 2030).
 - Introducing now intended to start a shift in the market and design approach
 - Example is occupancy sensors, previous secondary zone PAFs
- This analysis is also using/improving OS/Radiance which is intended as a first, exploratory step to Radiance in CBECC-Com



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3. Technical and Market Barriers

Technical and Market Barriers

- No significant barriers identified



- Available from several to many companies



- Fixed slats
 - Not yet widely-used (growing) but is long-established technique

- Clerestories
 - Long-established



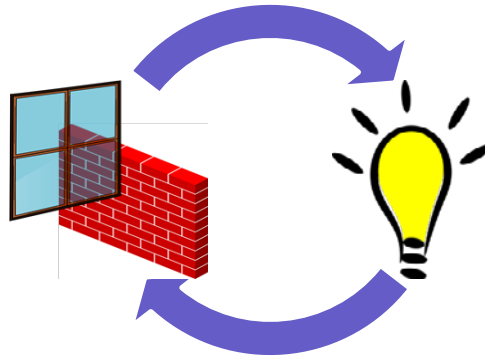
- Daylight Redirecting Devices
 - Window film installation skill set will need to increase



4. Compliance and Enforcement

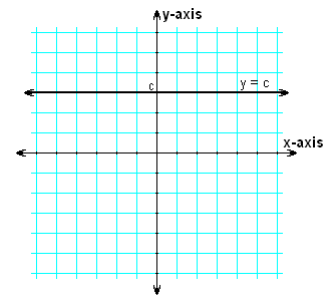
Compliance and Enforcement Barriers

- Coordination of Envelope and Lighting designers
 - Has been done in previous code (ca. 2005)
 - Call out both in code and in compliance manuals that these two disciplines will need to coordinate



Compliance and Enforcement Barriers

- Awareness of PAFs
 - Becoming aware of changes to code is typical practice in industry
 - IOUs offer classes and publications
- Completion of forms
 - New PAFs add labor-hours to form completion
 - Have form auto-calculate PAFs from given technology
- Persistence of savings
 - Permanent fasteners
 - Educate building owners, facility managers and tenants
 - Permanent label stating that removal may trigger code?
- Window film skill set
- Field inspector extra work



Feedback



1. Regarding Coordination of Envelope and Lighting designers, select all that apply:

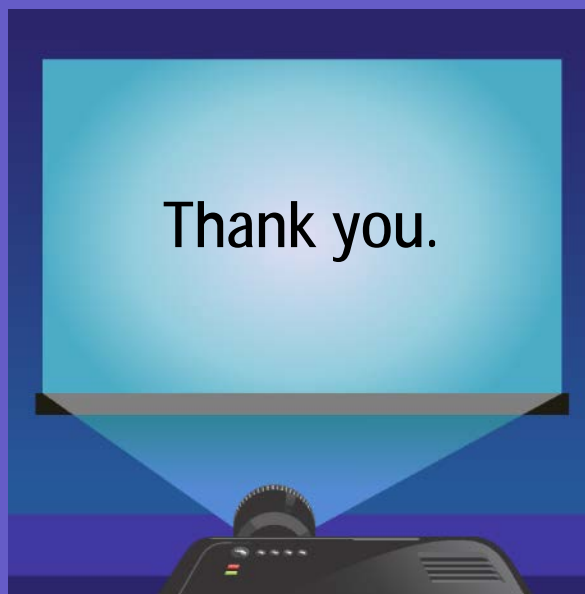
- a) We captured the issue correctly
- b) The proposed resolution seems reasonable
- c) CASE Team needs to spend more time thinking about this issue and the proposed resolution

Poll Questions

[for Reference pod]

Let's move on to...

Energy Impacts



- Eric Shadd
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5. Energy Impacts

Definition of Baseline and Proposed Conditions: Shade Glare Trigger

- **Metric Selection**

- DGI
 - Tested under diffuse sky
- VCP
 - Statistical but tested under artificial light
- CGI/UGR
 - Testing method not well known
- IES-LM-83
 - Sensitive to floor area, but code needs to tend towards insensitive
- Standard Deviation of Window
 - Very thorough, but currently only preliminary thresholds for criteria development

Definition of Baseline and Proposed Conditions: Shade Glare Trigger

- **Metric Selection**

- DGP was selected
 - Sensitive/Insensitive occupant via built-in selectable threshold (i.e. no hard threshold)
 - Large, varied sample size
 - 76 subjects from 2 countries
 - Verified in second study
- Proposed approach is more sensitive to shade closure
 - Whichever metric chosen, one sensitive, other insensitive. DGP falls more naturally into this.
 - Possible one metric triggers or doesn't trigger glare for a particular hour, but duration of blind closure is what actually affects daylighting savings.
- **DGP will not be in Title 24, Part 6. It was only used as a glare trigger for manual shades in the analysis**

Feedback



1. Regarding the glare trigger for manual shades, select the one that applies:

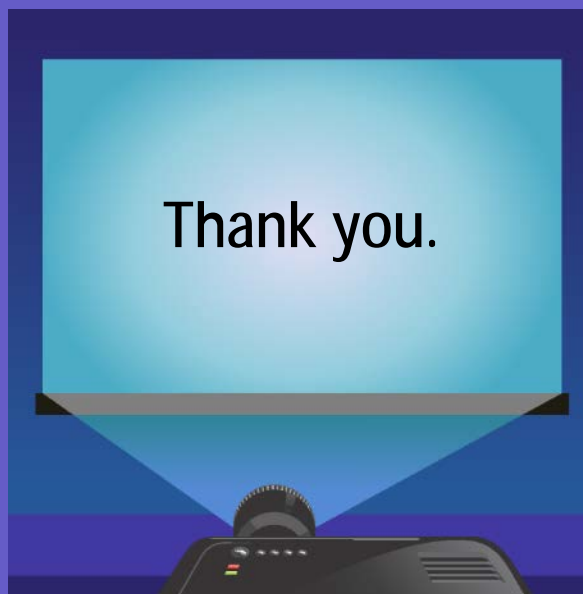
- a) The assumptions are good
- b) The assumptions are fair
- c) The assumptions are reasonable
- d) The assumptions may not be reasonable
- e) The assumptions are unreasonable

Poll Questions

[for Reference pod]

Let's move on to...

Energy Impacts



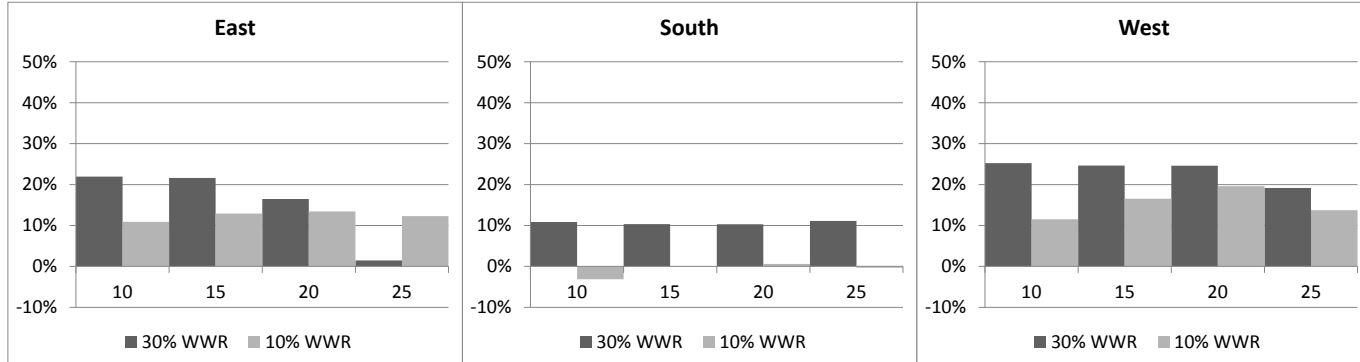
- Eric Shadd
- eric@Determinant-LL.Com

Cost-Effectiveness Analysis

- **Since PAFs are not requirements of the code, a cost-effectiveness analysis is not required.**

Annual Energy Savings Per Prototype: Fixed Slats

- **By Cutoff Angle (PZ, 300 lux, multilevel, ~15° slat)**
 - East/West drop at high WWR, but peak at 20 for low WWR
 - South insensitive (more about blocking glare than redirection)



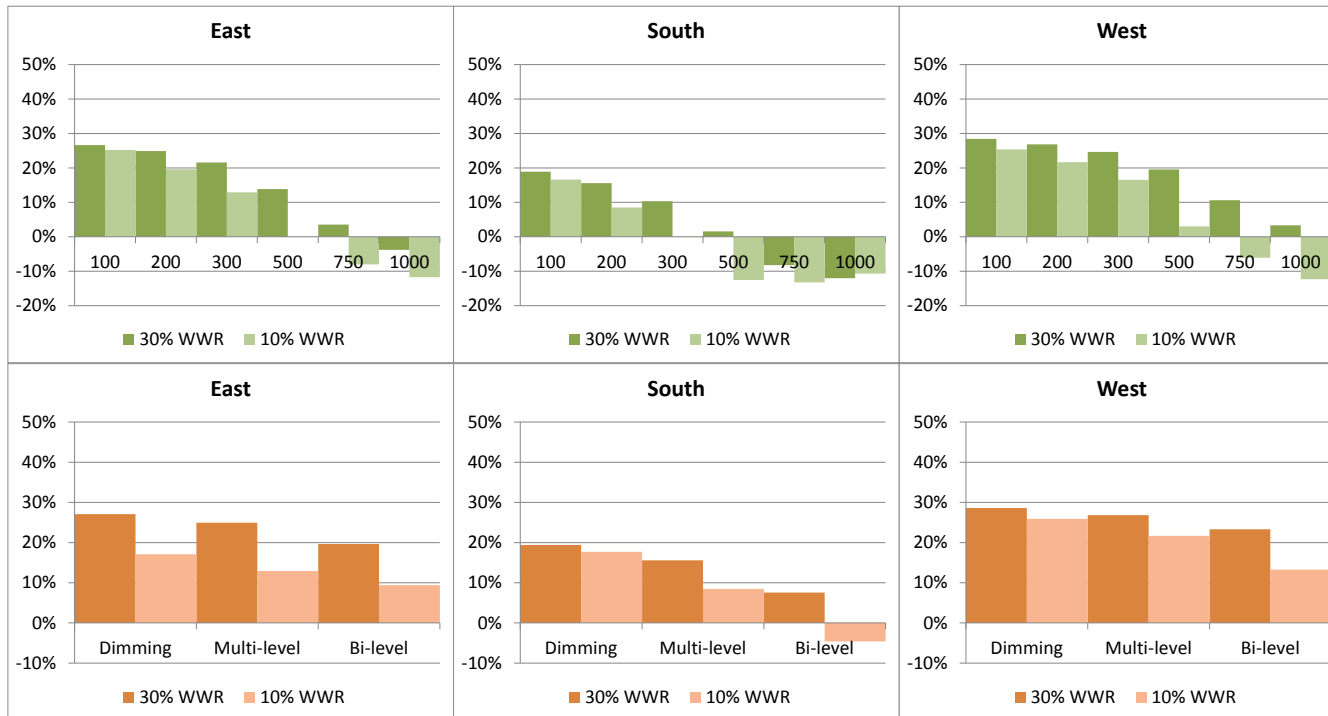
Annual Energy Savings Per Prototype: Fixed Slats

- **By Slat Angle and WWR (PZ, 300 lux, multilevel, 15/30° CO)**
 - East increase, West steadier, south constant, good higher WWRs
 - Best on East/West except 40% where glare again (not south)



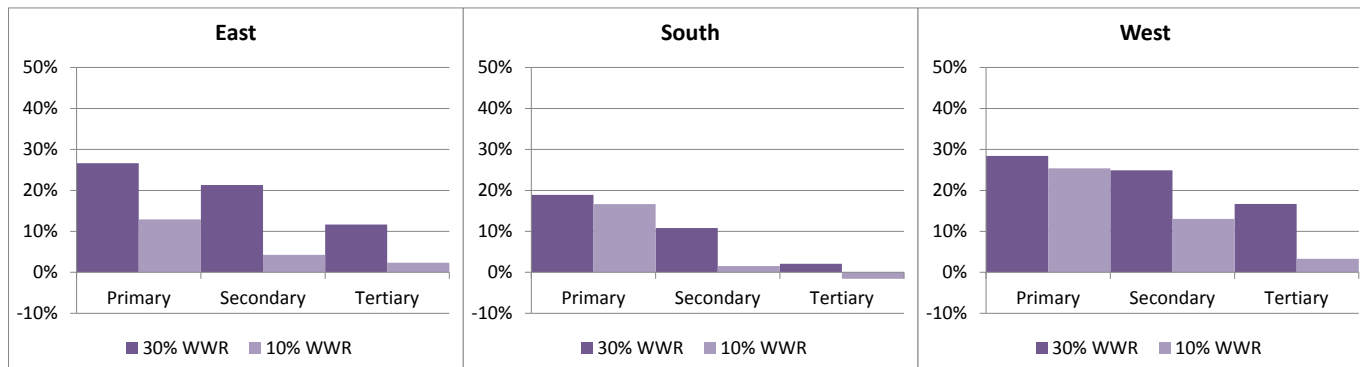
Annual Energy Savings Per Prototype: Fixed Slats

- **By Setpoint and Control (PZ, 300 lux, multilevel, 15/30° CO, ~15°)**
 - East/West better, drop off at higher SP, small increase w/WWR
 - East/West better, esp. West, all sensitive to control type



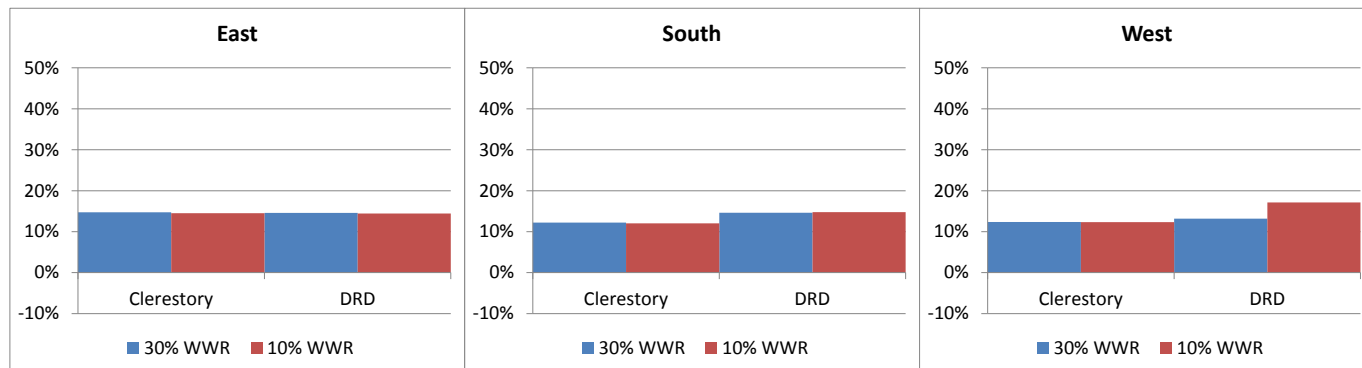
Annual Energy Savings Per Prototype: Fixed Slats

- **By Number of Zones (300 lux, multilevel, 15/30° CO, ~15°)**
 - All drop off
 - Secondary zone alone typically has negative savings, but together still net gain



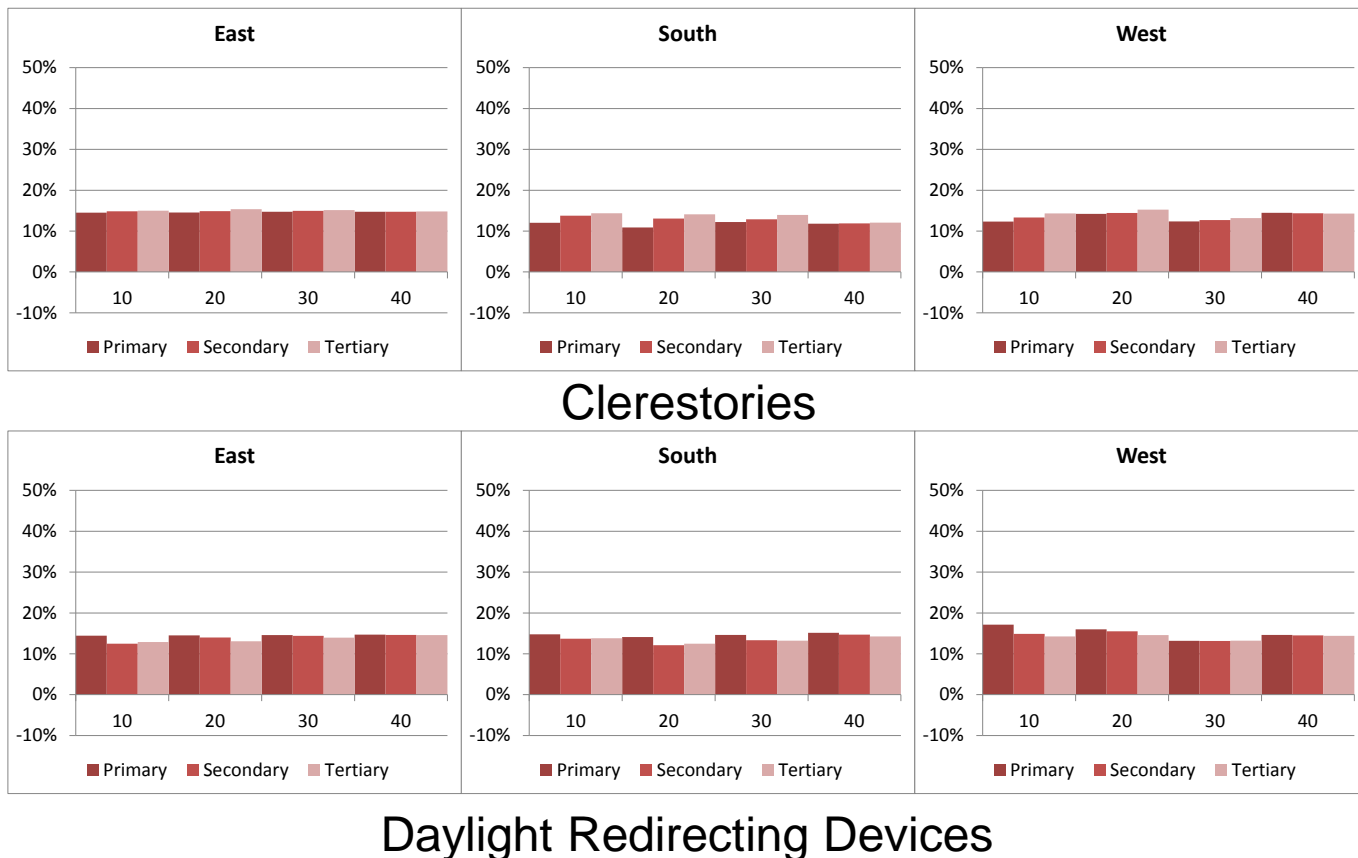
Annual Energy Savings Per Prototype: Clerestories and DRD

- **By Technology (PZ, 300 lux, multilevel)**
 - Similar East/West, but DRD better on south (high solar altitude)
 - WWR insensitive



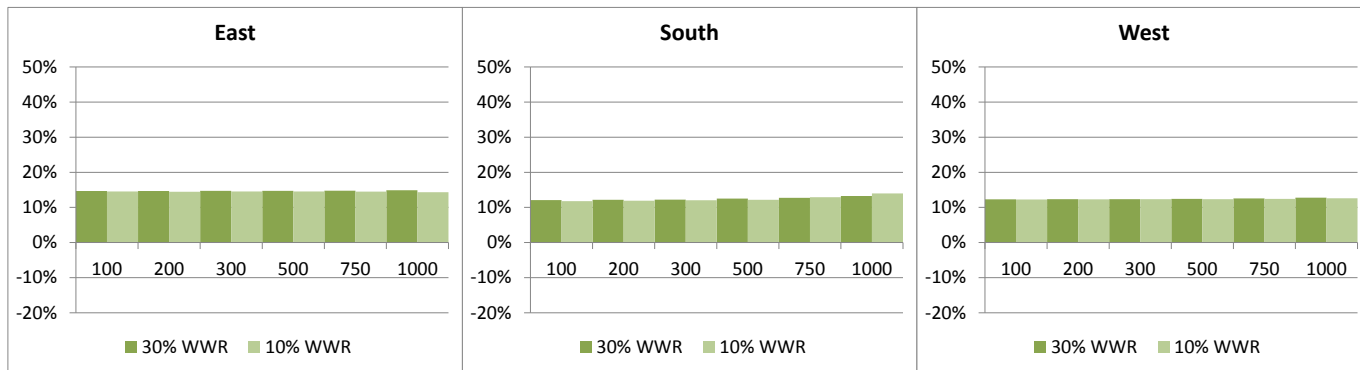
Annual Energy Savings Per Prototype: Clerestories and DRD

- **By WWR (PZ, 300 lux, multilevel)**
 - Similar, but DRD better on west and south (solar alt, TDV duck)

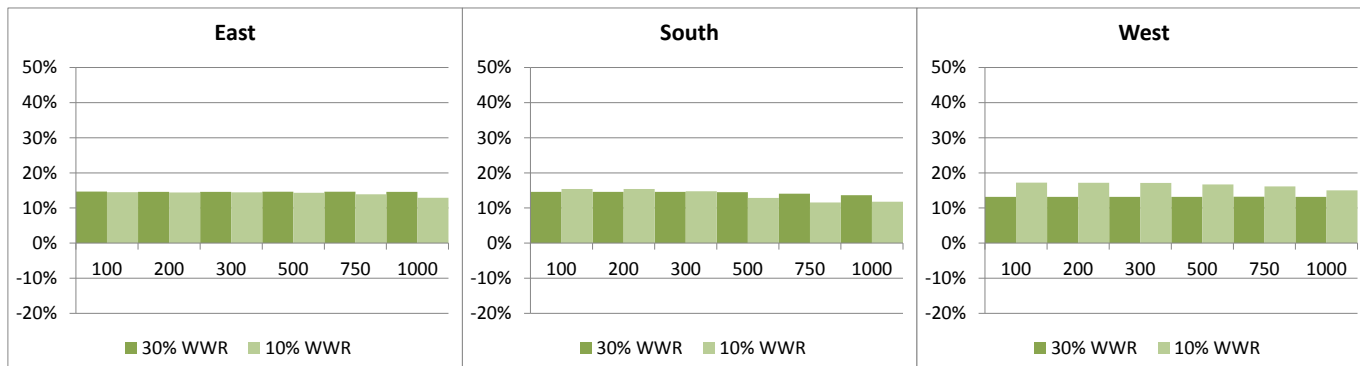


Annual Energy Savings Per Prototype : Clerestories and DRD

- **By Setpoint (PZ, multilevel)**
 - Savings insensitive to setpoint
 - West higher savings again



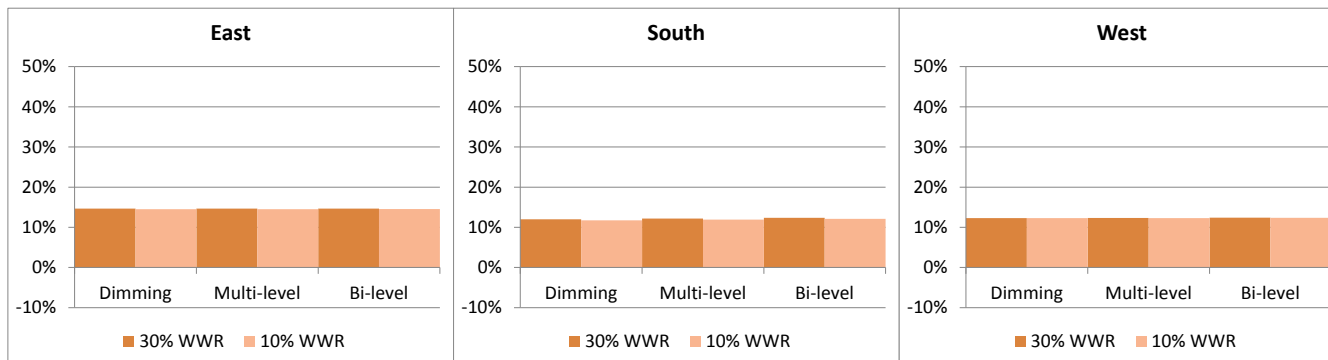
Clerestories



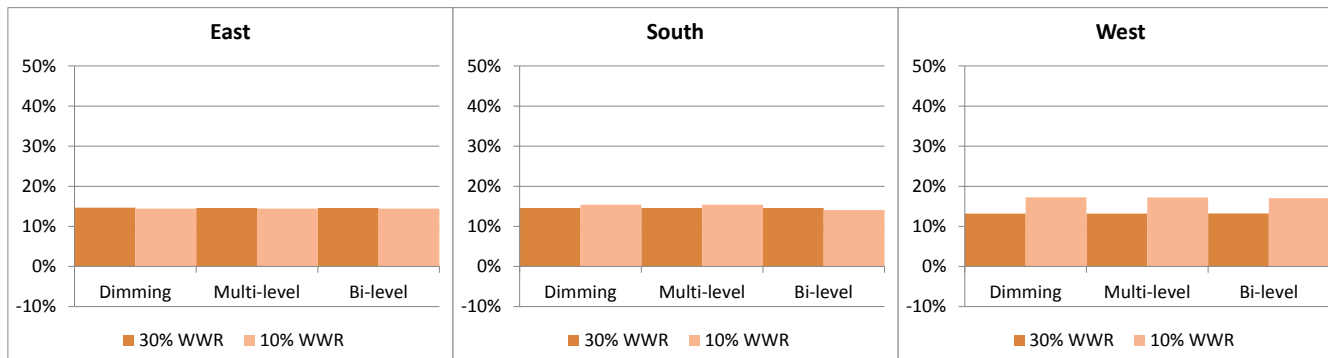
Daylight Redirecting Devices

Annual Energy Savings Per Prototype : Clerestories and DRD

- **By Control Type (PZ, 300 lux, multilevel)**
 - Generally independent of control type (hints at possibility of even deeper daylight zones)



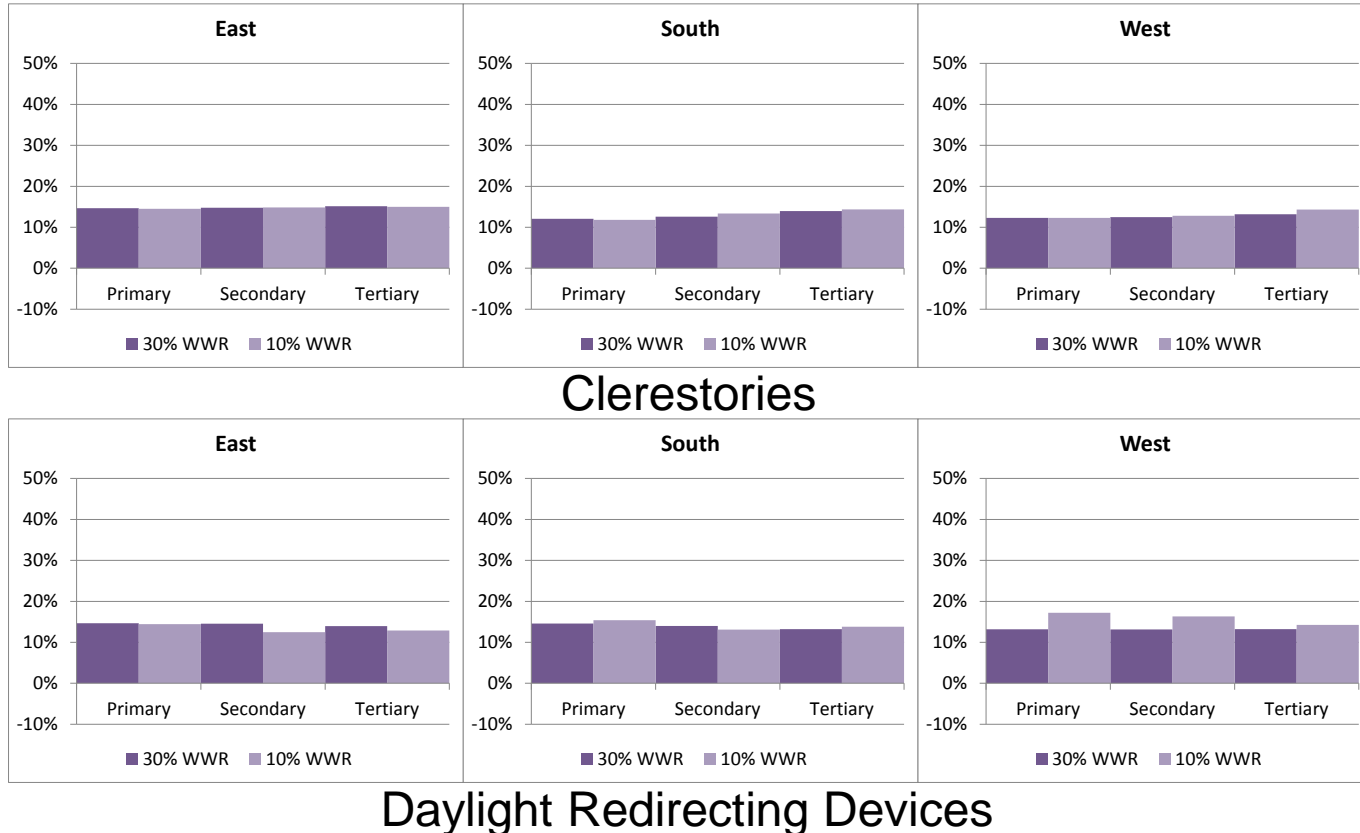
Clerestories



Daylight Redirecting Devices

Annual Energy Savings Per Prototype : Clerestories and DRD

- **By Number of Zones (300 lux, multilevel)**
 - Clerestories: even on East/West, South increase (deeper throw)
 - DRD: comparable on East but South and West higher



Discussion



1. What is your reaction to energy savings results?
 - a) Savings are way too high
 - b) Savings are a little too high
 - c) Savings are seem about right
 - d) Savings are little too low
 - e) Savings are way to low
 - f) I don't know

6. Next Steps

Next Steps

- Add southeast and southwest to analysis
- Further optimize clerestories and DRD
- Investigate PAF table simplifications

Next Steps

- Please send any additional feedback within 2 weeks to:
 - CASE Author (see contact info at end of this presentation)
 - Info@title24stakeholders.com
- Keep an eye on Title24Stakeholders.com for:
 - Presentations from today's meeting
 - Draft Code Change Language
 - Notes from today's meeting
 - Draft CASE Report (will be posted in April)
- CEC pre-rulemaking workshop on **xxxx**.

Thank you.

Eric Shadd

eric@determinant-LL.Com



Appendix

References

- [Title24Stakeholders.com](https://www.title24stakeholders.com)
- [EnergyCodeAce.com](https://www.energycodeace.com)
 - See [Reference Ace](#) for 2016 Standards, Appendices, and Compliance Manuals
- [California Energy Commission 2019 Standards Webpage](#)