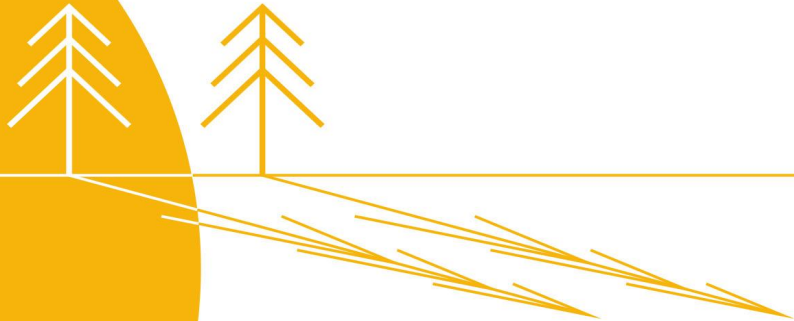


Spring Education Seminar: A Complete Picture of Daylight

Daniel Glaser, PhD Principal, LightStanza
Pacific Energy Center, San Francisco, June 9, 2016

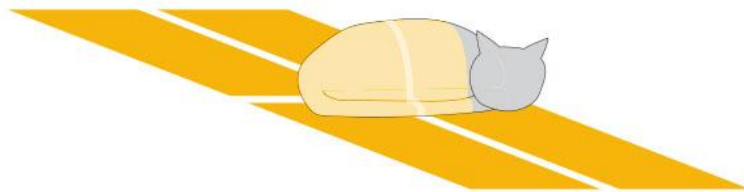


Agenda

1. Overview of major differences between LEED v2009 & LEED v4
2. LEED v4 Daylighting EQc7: Compliance Paths
3. Daylighting Metrics: How to Engage & Interpret
4. Going Beyond the Workplane
5. Advanced Topics
6. Daylight Metrics In-Class Exercise
7. Case Study/Demo
8. Q&A

How do you use daylighting?

- Architects? Consultants? Lighting Designers? Engineers? Students? Software Developers?
- Who has pursued the LEED v2009 daylight credit?
- Who has pursued the LEED v4 daylight credit?
- What specifically do you want to get from this talk?



LEED v2009 vs. LEED v4: Intent

To provide building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views in the the regularly occupied areas of the building.

LEED v2009 IEQc8.1 - Daylight



To connect building occupants with the outdoors, **reinforce circadian rhythms**, and **reduce the use of electrical lighting** by introducing daylight into the space.

LEED v4 EQc7 - Daylight



LEED v2009 vs. LEED v4: Daylight Prevalence

Indoor Environmental Quality: 4/15



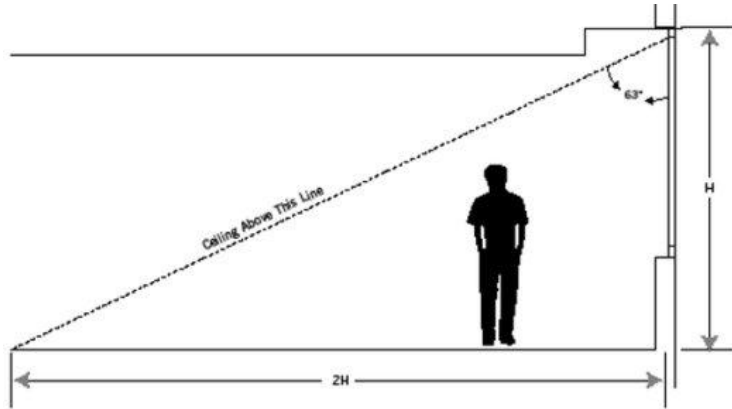
LEED v2009 IEQc8.1 - Daylight

Indoor Environmental Quality: 6/16



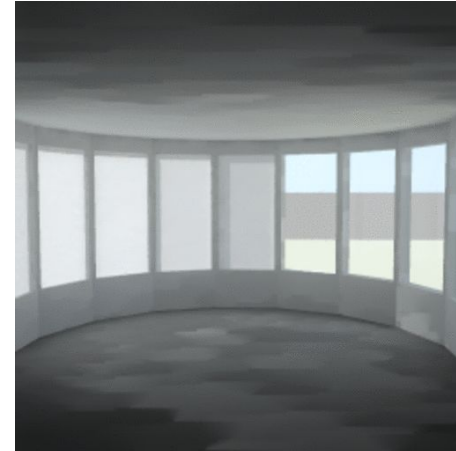
LEED v4 EQc7 - Daylight

LEED v2009 vs. LEED v4: Process



Allows simplified **prescriptive** path for full credit.

LEED v2009 IEQc8.1 - Daylight



March 21, 09:00 AM

Requires robust **annual simulation** (ASE & sDA) for full credit.

LEED v4 EQc7 - Daylight

LEED v4 Daylighting EQc7: Compliance Paths

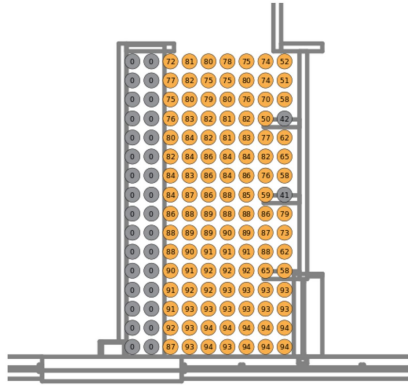
ASE

✗ 65.28 %



sDA

✓ 75.69 %



Option 1 (2-3 Points): Simulation: Spatial Daylight Autonomy (sDA) & Annual Sunlight Exposure (ASE)

1. Demonstrate through annual computer simulations that Spatial Daylight Autonomy_{300/50%} of at least 55%, 75%, or 90% is achieved. Use regularly occupied floor area.
2. Demonstrate through annual computer simulations that Annual Sunlight Exposure_{1000,250} of no more than 10% is achieved. Use regularly occupied floor area that is daylit per the sDA simulations.

A Complete Picture of Daylight, D. Glaser
Pacific Energy Center, 6/9/2016
Copyright © Light Foundry LLC

LEED v4 Daylighting EQc7: Compliance Paths

✗ 67.36% September 21, 9:00am & 3:00pm



Option 2 (1-2 Points): Simulation: Illuminance Calculations

1. Demonstrate through computer modeling that illuminance levels will be between 300 lux and 3,000 lux for 9 a.m. and 3 p.m., both on a clear-sky day at the equinox. Use regularly occupied floor area.

Daylighting Metrics: How to Engage & Interpret

How to Simulate for Daylight?



Varies by Sky Type



Varies by Season



Varies by Hour





Precedents: DA, cDA, & UDI

Daylight Autonomy (DA)

*The percentage of the time-in-use that a certain user-defined lux threshold is reached through the use of just **daylight**. DA is a useful metric for determining potential savings with an on/off dimming system.*

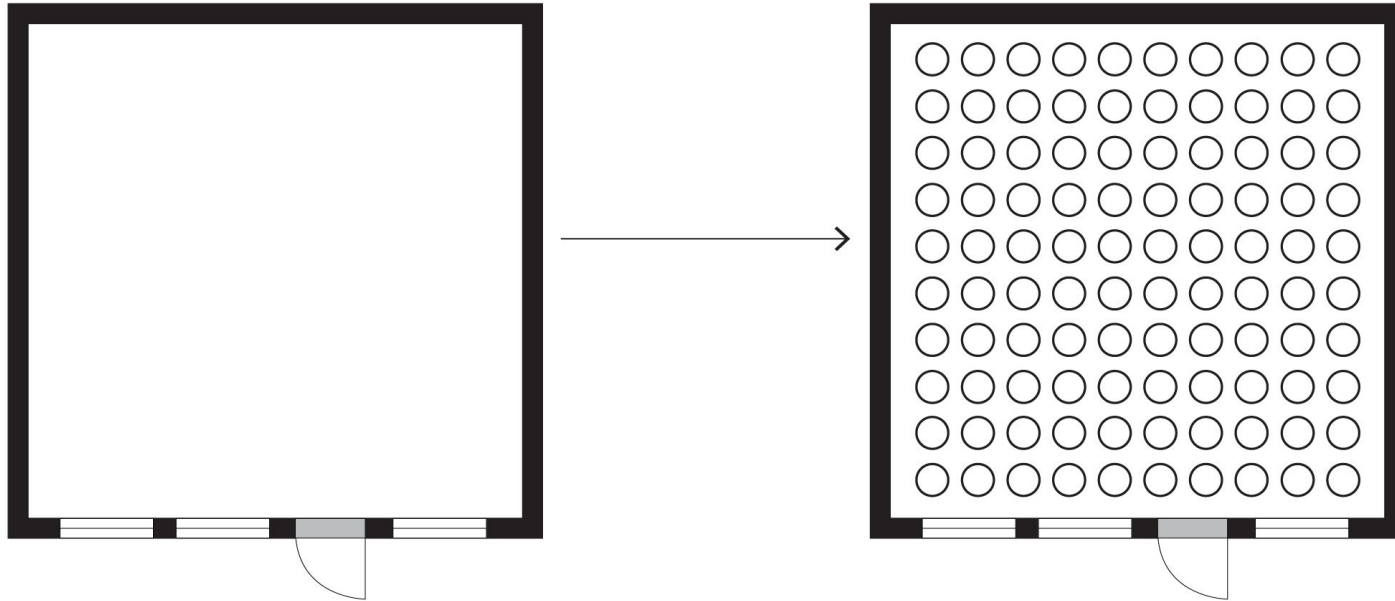


Daylight Autonomy (DA)

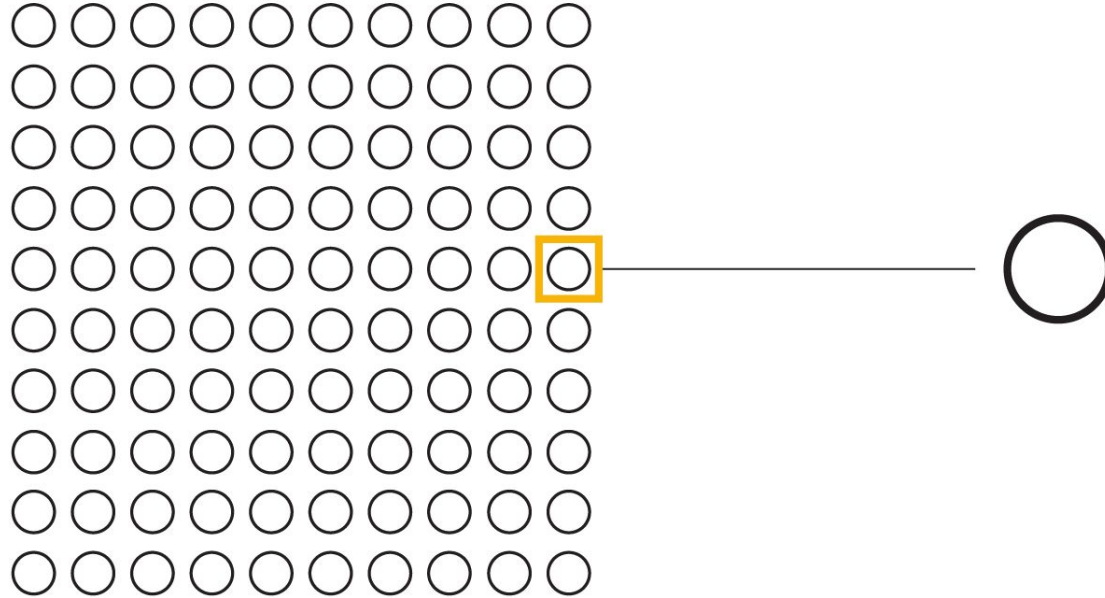
*The percentage of the time-in-use that a certain user-defined lux threshold is reached through the use of just **daylight**. DA is a useful metric for determining potential savings with an on/off dimming system.*



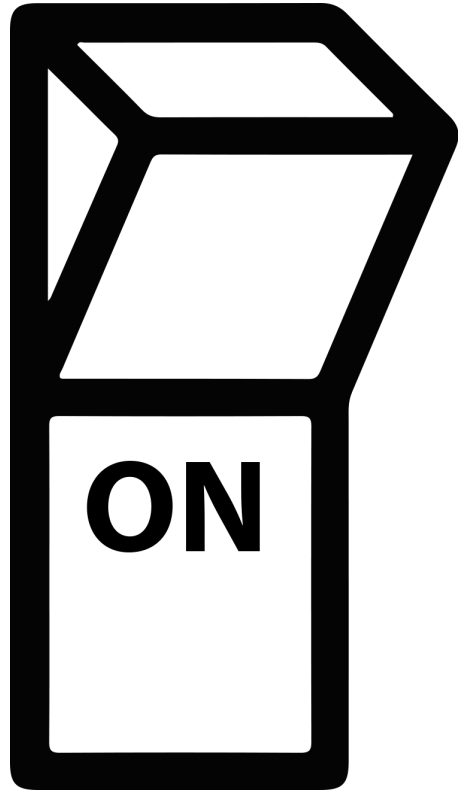
Create A Grid



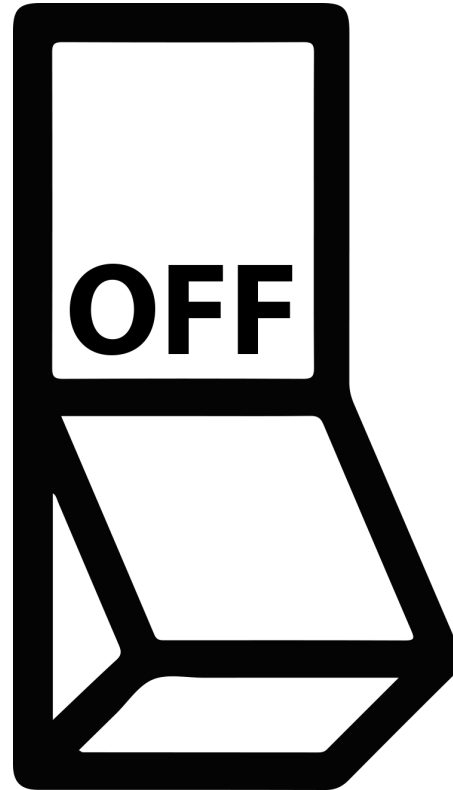
Start By Looking at a Single Point



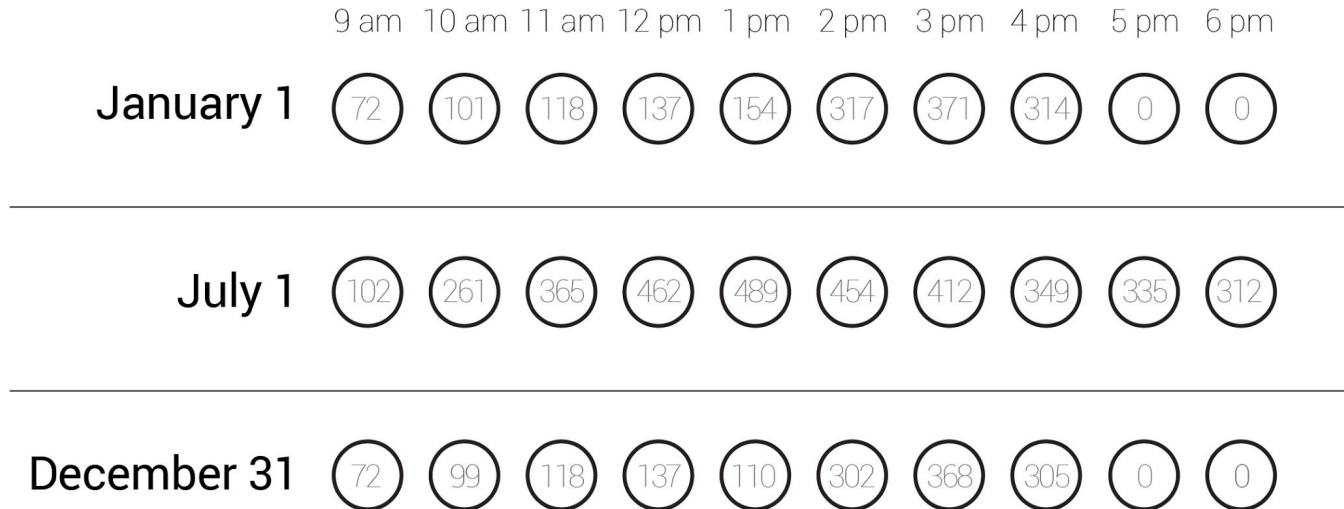
23



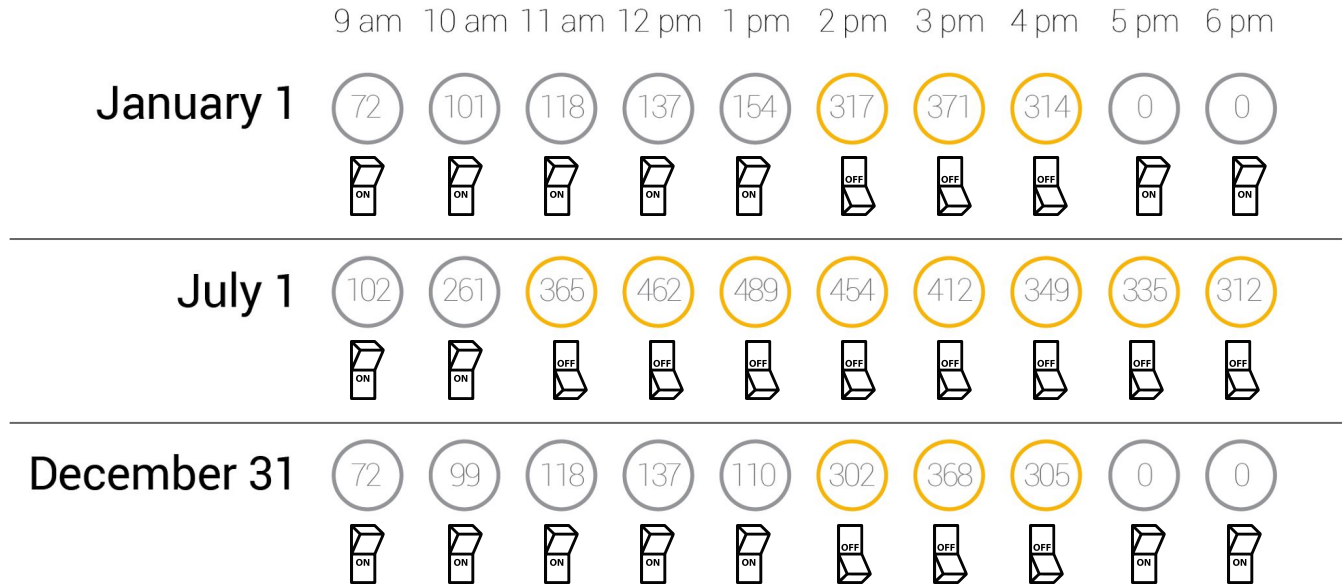
342



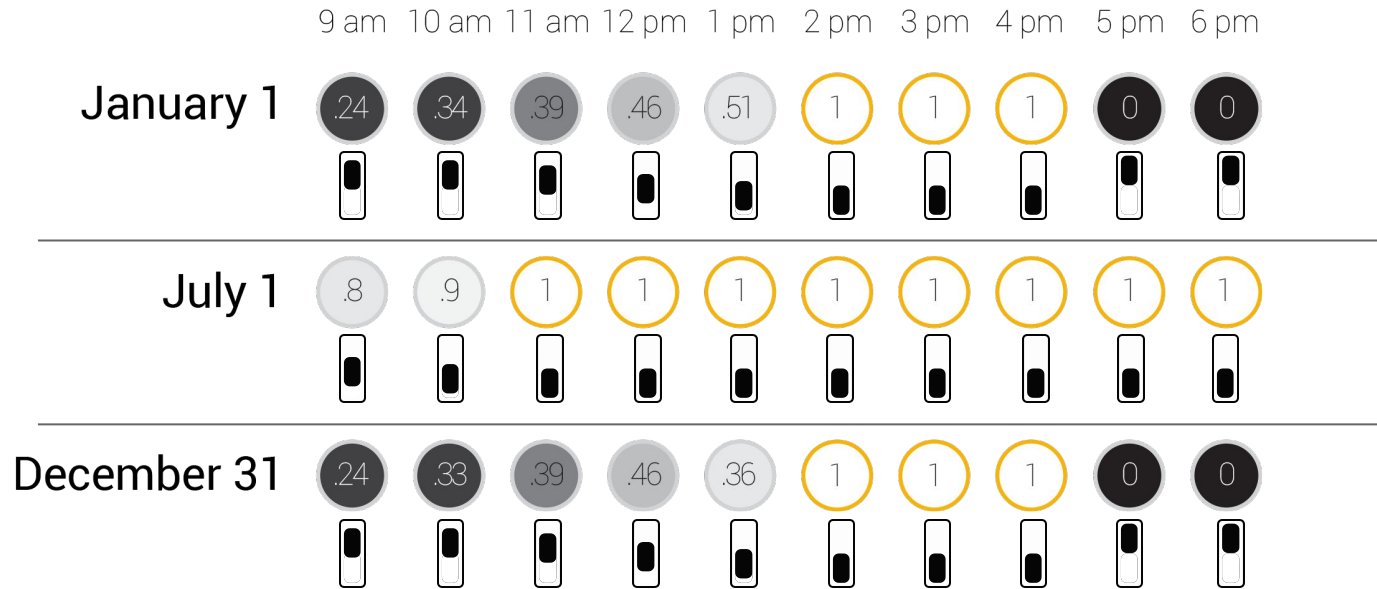
Measure Point's Illuminance Hourly



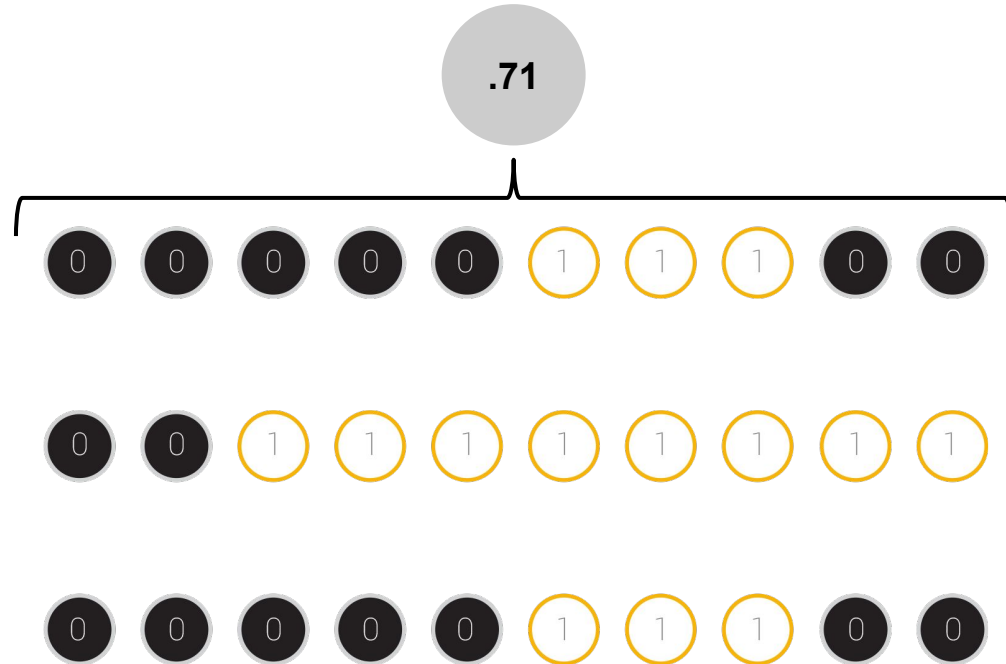
Determine if Point Meets Target Threshold (300 lux)



Continuous Daylight Autonomy (cDA) - Partial Credit

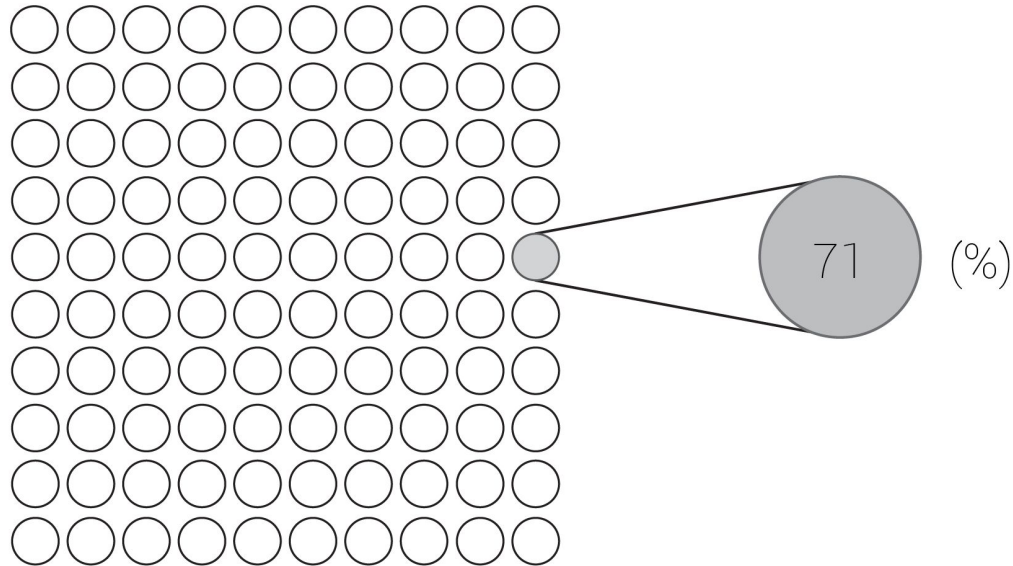


Average Across Year

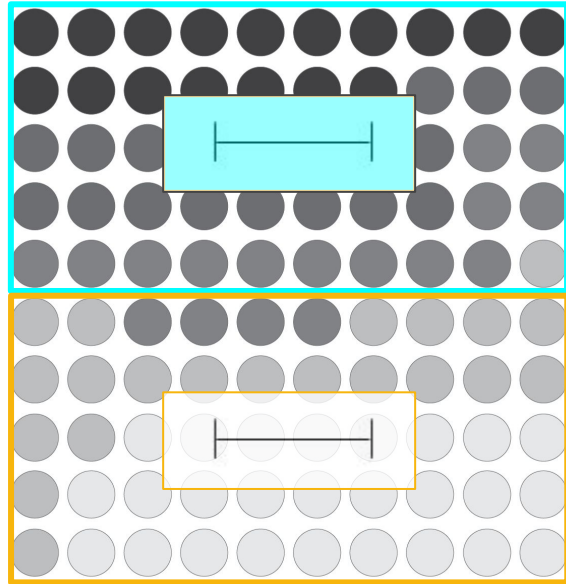


Score Each Point

Percent of time at or above illuminance threshold of 300 lux



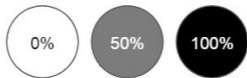
Final Result



Daylight Autonomy 300 lux = 27%
- Light **On**

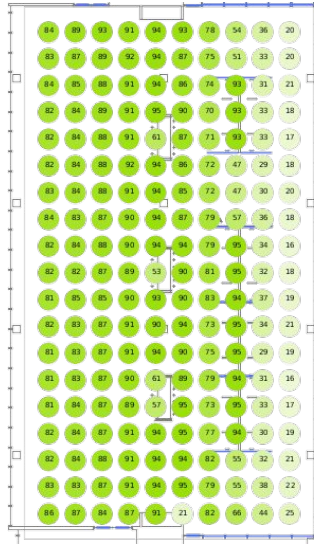
Daylight Autonomy 300 lux = 82%
- Light **Off**

percent of time meeting target illuminance of 300 lux (with partial credit)



Useful Daylight Illuminance (UDI)

72.39 %



percent of time within target illuminance range (100 - 3000 lux)



The New LEED v4 Metrics: ASE & sDA

ASE 1000 250h



ASE_{1000, 250h}

Annual Sunlight Exposure



Annual Sunlight Exposure: First Measure Workplane



A Complete Picture of Daylight, D. Glaser
Pacific Energy Center, 6/9/2016
Copyright © Light Foundry LLC

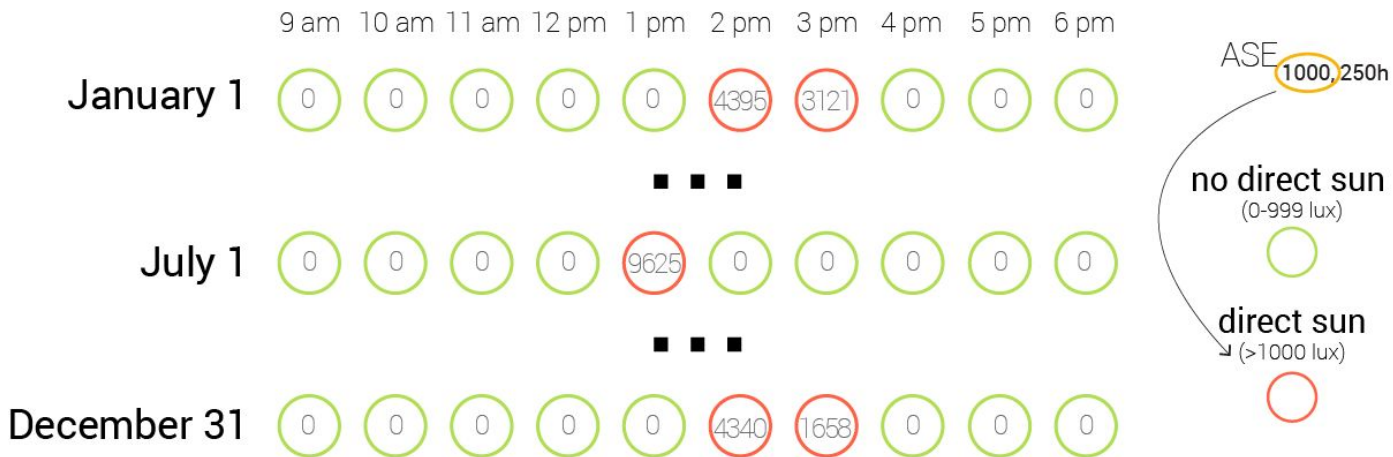
Evaluate Lighting Levels

3,438h 

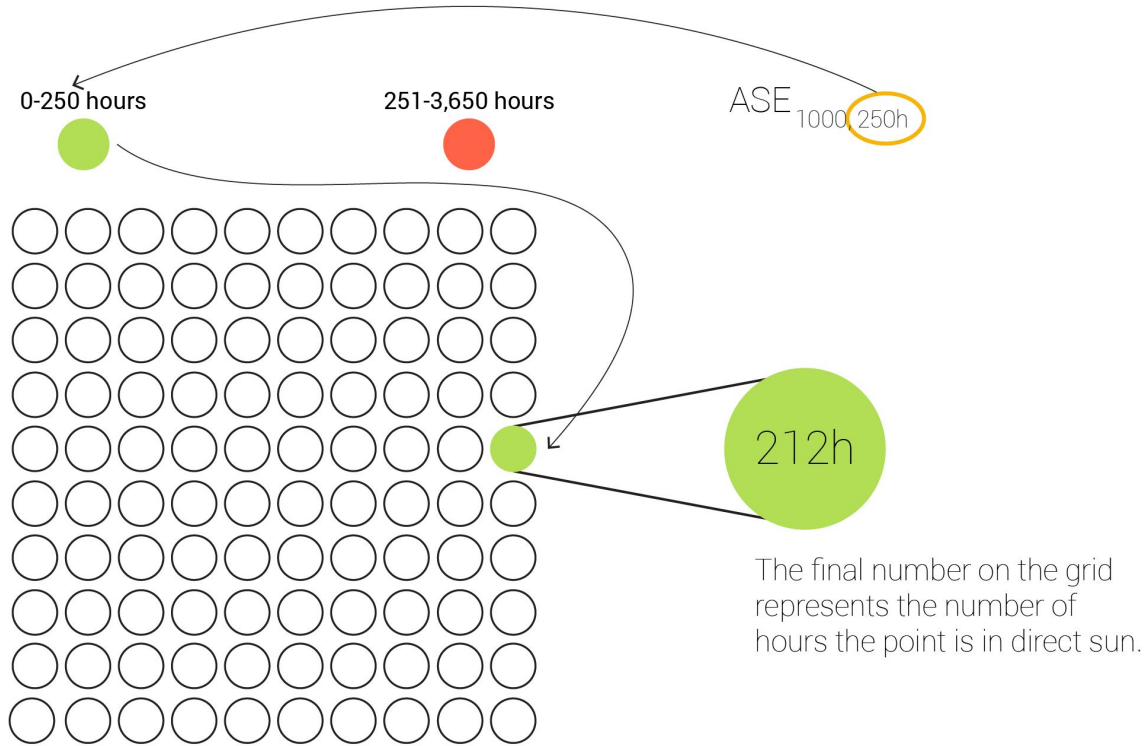
The point is not in direct sun for 3,438 hours.

 212h

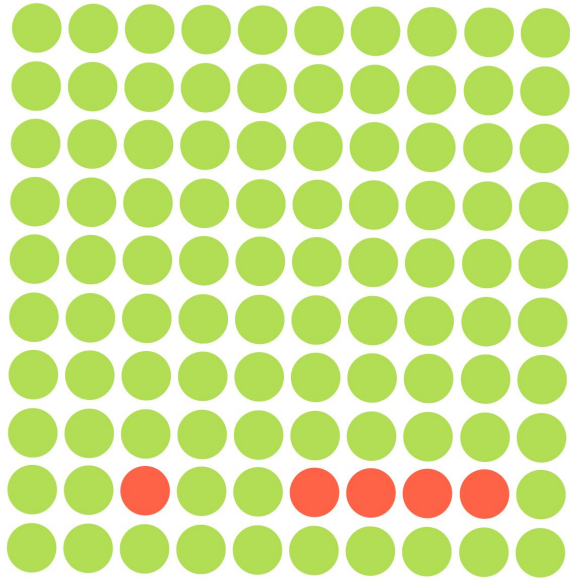
The point is in direct sun for 212 hours.



Score Each Point



Final Result



0-10% - acceptable

10.01-100% - unacceptable

95



Points on the grid that
are in direct sun for
less than 250 hours.

5

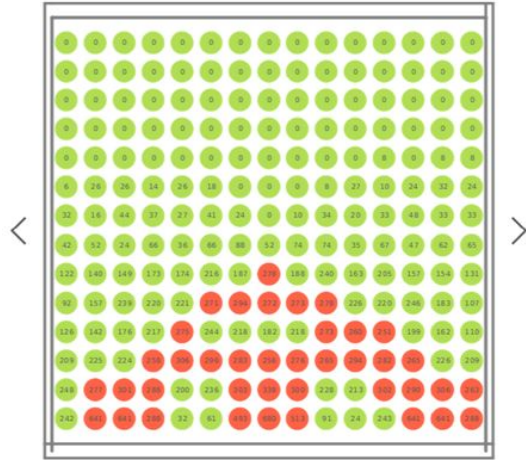


Points on the grid that
are in direct sun for
more than 250 hours.

5% - *acceptable*

Classroom Example: No Overhangs or Shelves

✗ 18.57 %

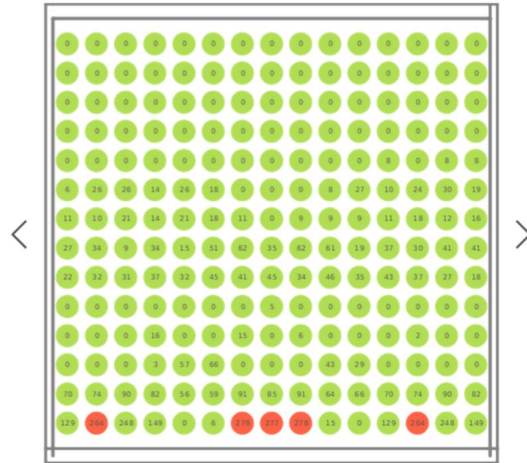


Hours of direct sun/year

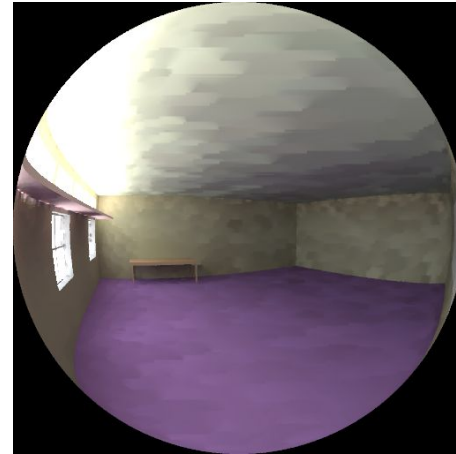


Classroom Example: With Overhangs and Shelves

✓ 2.38 %



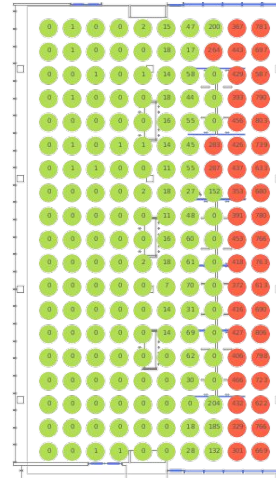
Hours of direct sun/year



Office Example

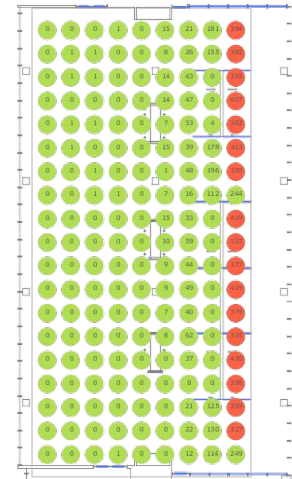


ASE = 21.5% ✗



Removal of
Circulation Area:

ASE=9.5% ✓



Hours of direct sun/year

<250h

>250h

Institutional Example



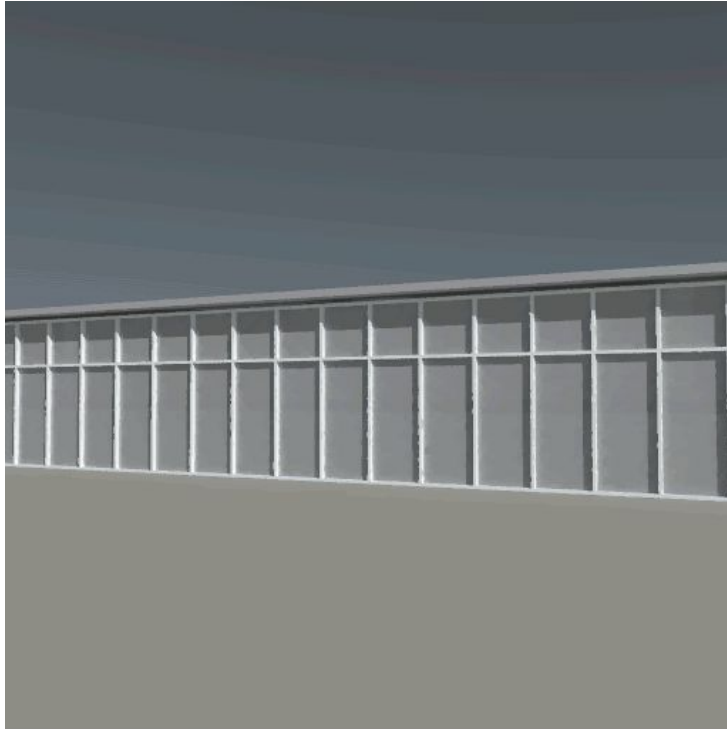
SDA_{300/50%}



Blinds Operation Informs Electricity Use



Blinds Operation: Human Aspect

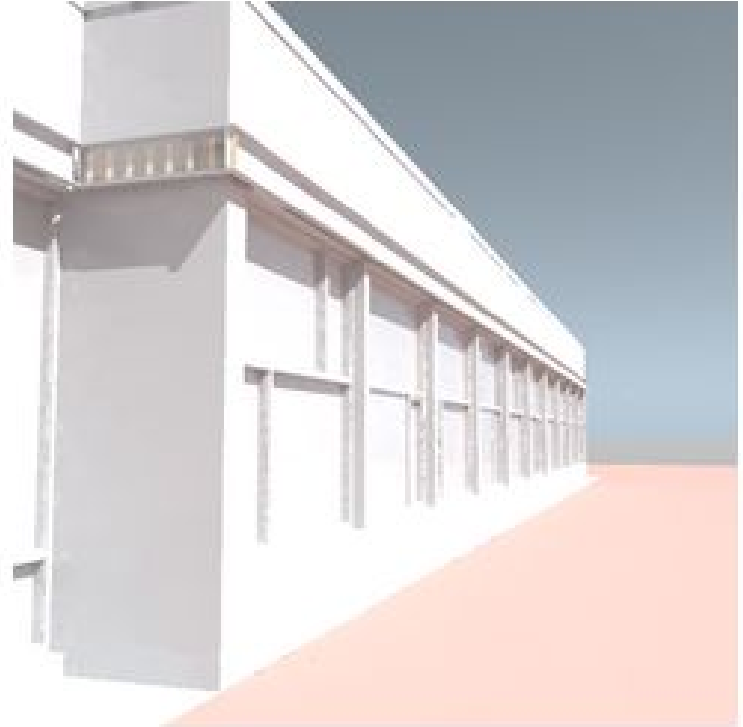


March 21, 09:00 AM



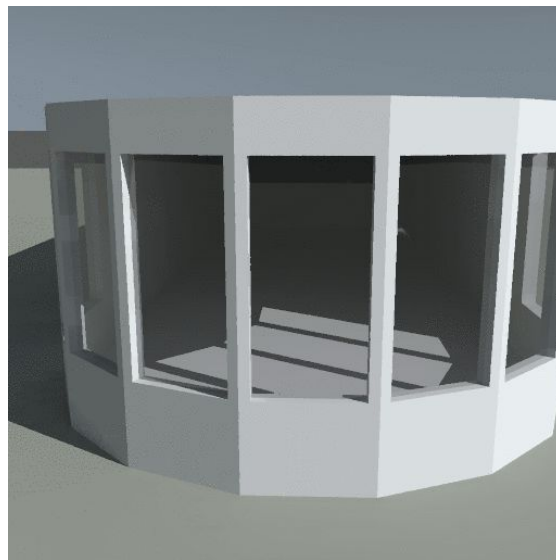
March 21, 09:00 AM

sDA Measures Realistic Daylight Availability



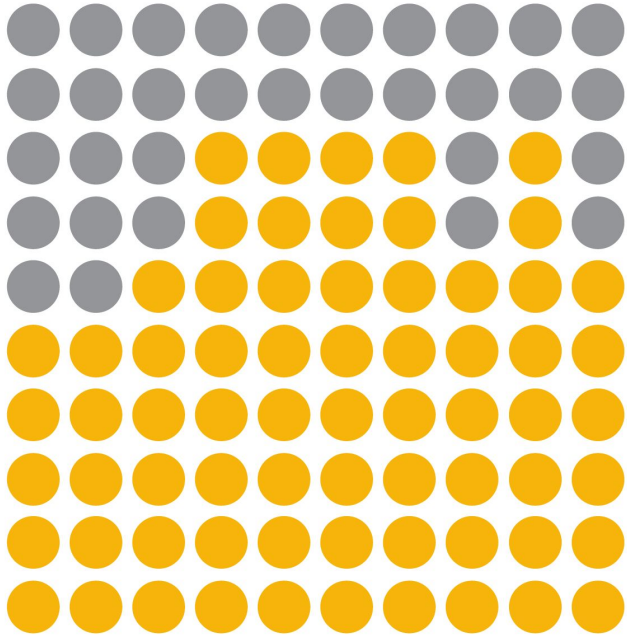


March 21, 09:00 AM
40.015, -105.271
Blinds sDA Specification



March 21, 09:00 AM
40.015, -105.271
Blinds sDA Specification

sDA_{300/50%} Sample Space



68



Points on the grid meet the threshold for at least 50% of the time.

32



Points on the grid do not meet the threshold for at least 50% of the time.

68% - *nominally acceptable*

0-54.99% - unacceptable

55-74.99% - nominally acceptable (2 points)

75-100% - preferred (3 points)

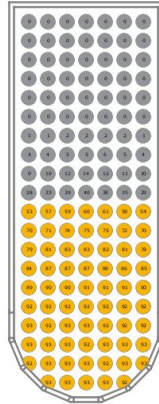
Over Predicting Daylight Availability

WITH BLINDS

Spatial Daylight Autonomy_{300,50%} (SDA)
Workplane



✗ 49.28 %



% of time at minimum illuminance threshold



< 50%

> 50%

(0-1,824 hours)

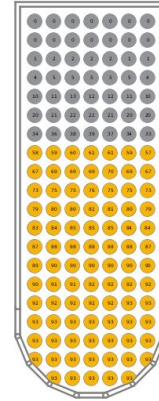
(1,825-3,650 hours)

WITHOUT BLINDS

Spatial Daylight Autonomy_{300,50%} (SDA)
Workplane



✓ 64.49 %



% of time at minimum illuminance threshold



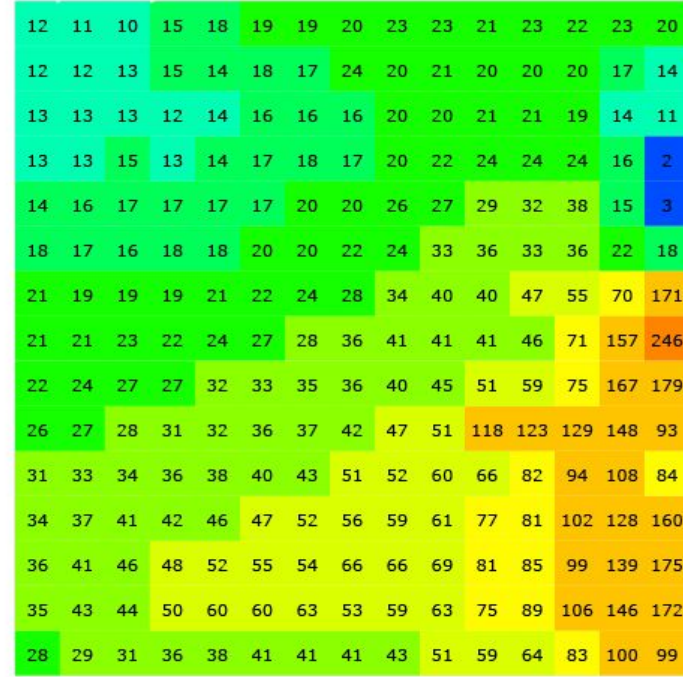
< 50%

> 50%

(0-1,824 hours)

(1,825-3,650 hours)

Workplane Limitations



Going Beyond the Workplane

New Standards Like WELL™ Focus on Occupant Comfort

1. Lack of exposure to natural light has harmful effects on quality of sleep, level of alertness, emotional state, and overall wellbeing.
2. Up and coming protocols to help the body maintain circadian alignment and achieve:
 - a. ideal lighting levels for various tasks
 - b. reduced eye-strain and glare
 - c. increased alertness
 - d. improved quality of sleep
 - e. decreased seasonal affective disorder
 - f. Vitamin D synthesis



*CBRE Headquarters, Los Angeles, CA
First WELL Certified™ Office*

Qualitative Measurements for Occupant Comfort

June 21, 12:00 pm



34,833.4 max 0.0 min 650.9 avg 0.0 avg/min 53.5 max/avg 0.0 max/min

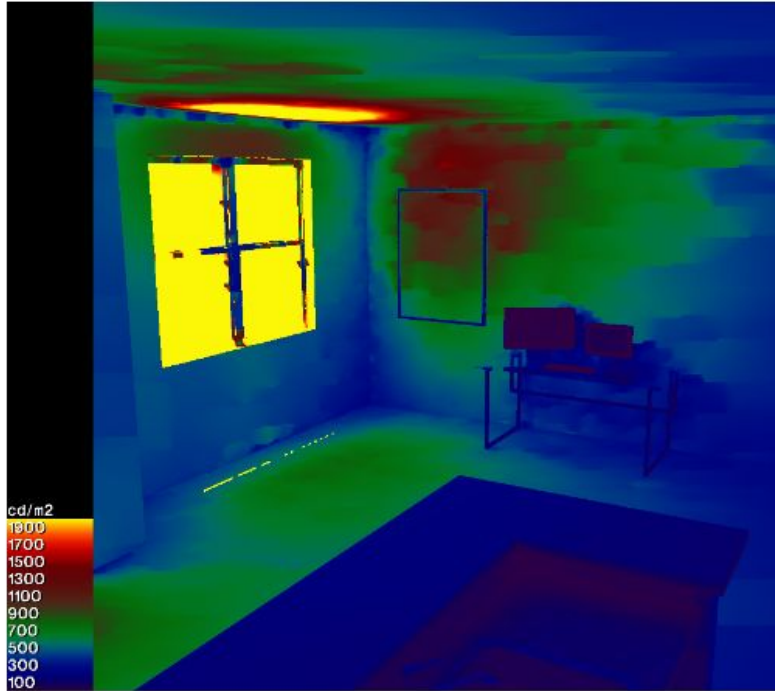
December 21, 12:00 pm



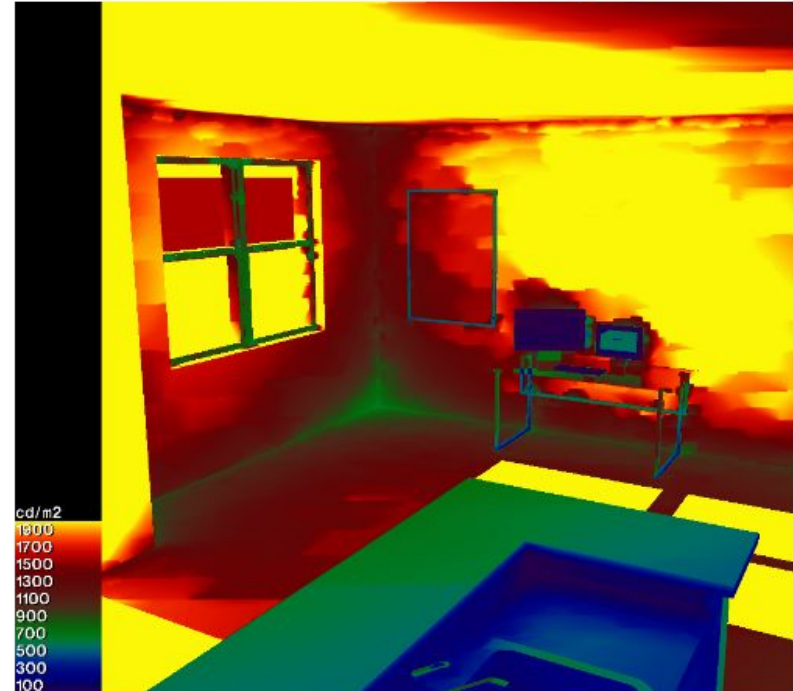
10,997.8 max 0.0 min 1,455.7 avg 0.0 avg/min 7.6 max/avg 0.0 max/min

Qualitative Measurements for Occupant Comfort

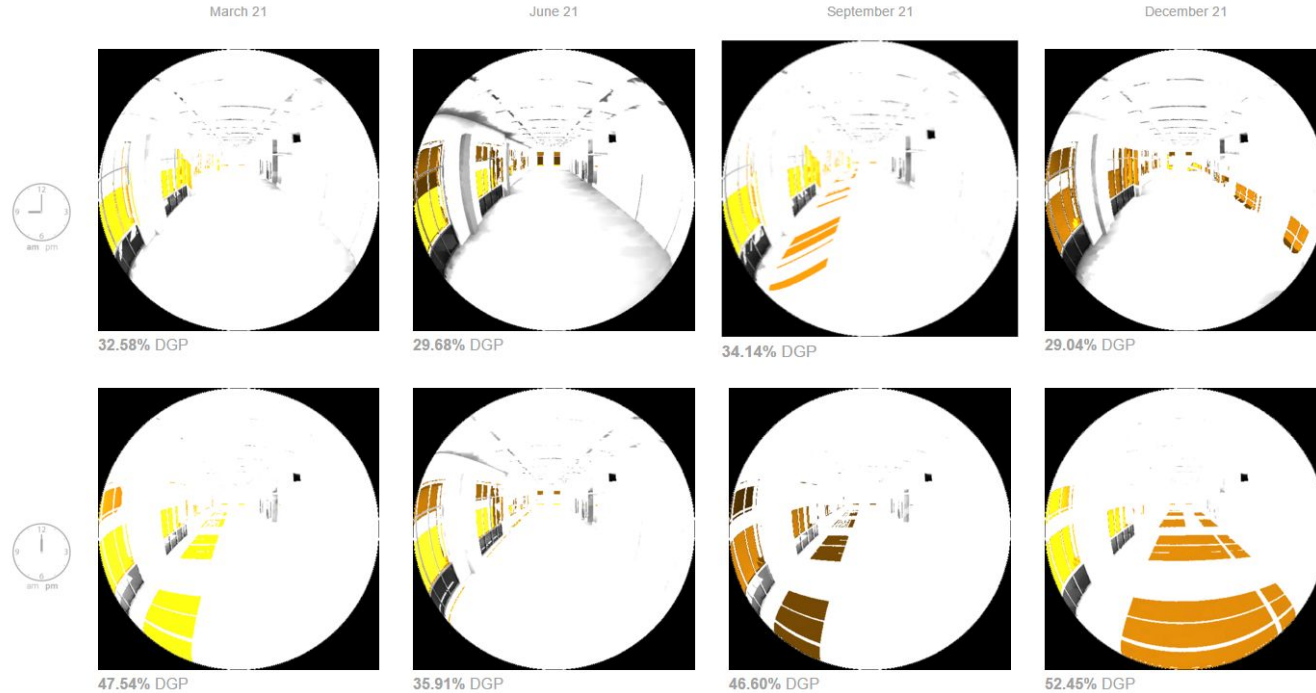
June 21, 12:00 pm



December 21, 12:00 pm



Daylight Glare Probability



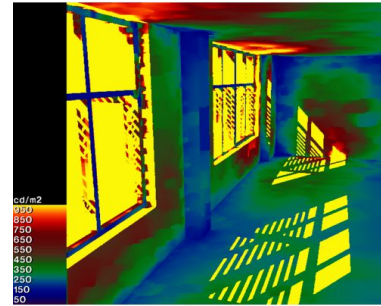
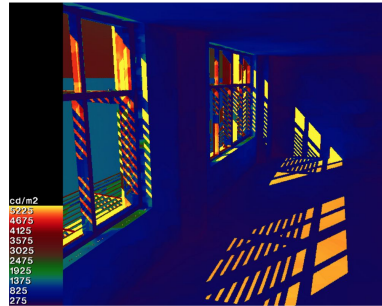
0-35% Imperceptible, 35-40% Perceptible, 40-45% Disturbing, 45-100% Intolerable

Iterations of Glazing Properties

40% Window Transmittance (VLT)



60% Window Transmittance (VLT)



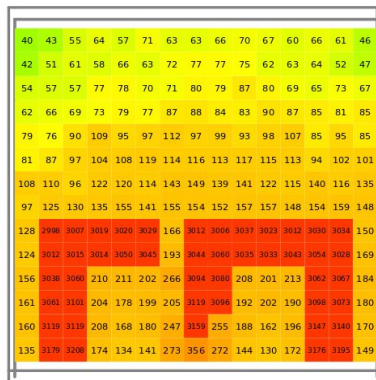
Model Design by RNL Design

Experiment with Different Products

80% VT



December 21, 12:00 PM

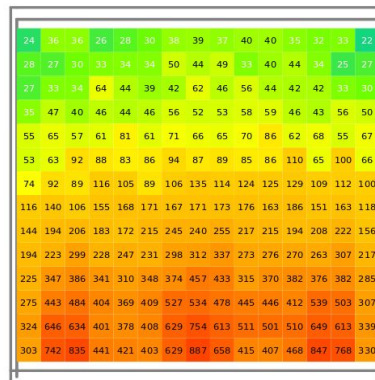


December 21, 12:00 PM

Redirecting Film 1

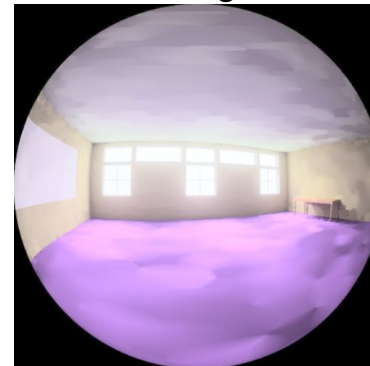


December 21, 12:00 PM

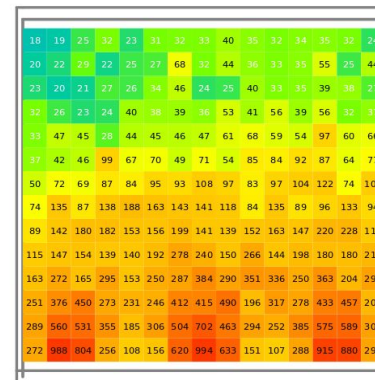


December 21, 12:00 PM

Redirecting Film 2



December 21, 12:00 PM



December 21, 12:00 PM

Iterations of Glazing Properties

Open Office 123 windows at **60% VT**



ASE score **15.07%**

Open Office 123 windows at **40% VT**



ASE score **10.96%**

Case Study: Focus on Details

LightStanza [Home](#) [Projects](#) [More](#)

Projects > Green Schools > K8 School2 expl 13 no vertical > aspen No trellis : Analyze **Model Setup**

aspen No trellis simple advanced Load settings from Cancel Save As

Materials Window Groups Site Layers Illuminance Grids Viewpoints

Material	DT	ST	DR	SR	A	RA
Translucent_Glass_Tinted						91.8%
[Translucent_Glass_Tinted]1						91.8%
[Translucent_Glass_Tinted]1						91.8%

Translucent

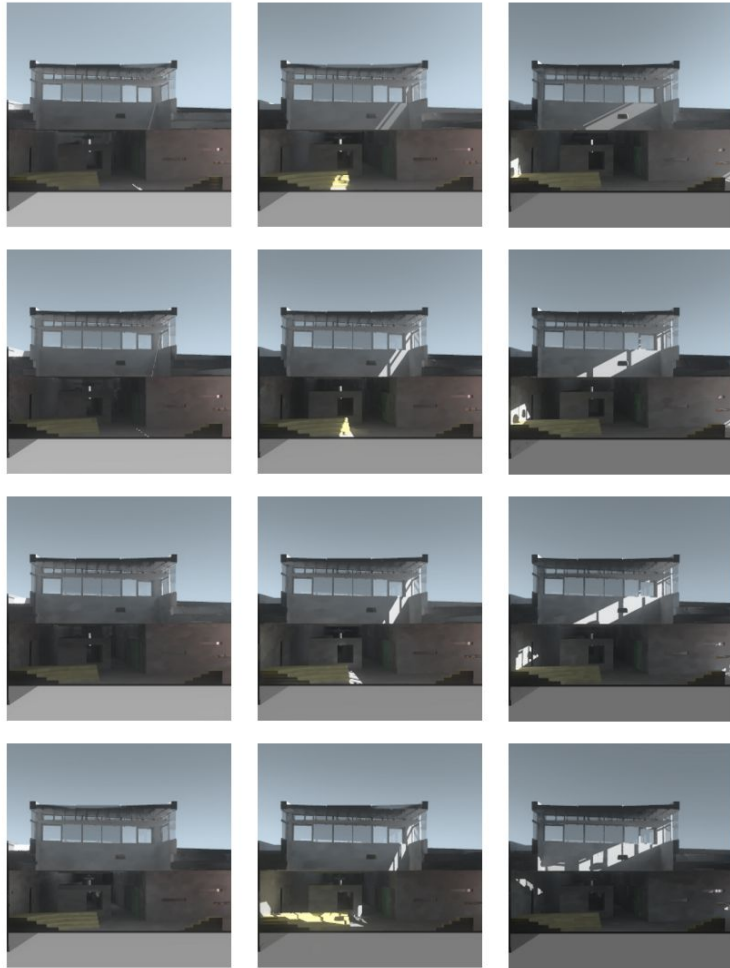
Material	Color	Ref.
Google Earth Snapshot		30.8%
Google Earth Snapshot#1		32.4%
Google Earth Snapshot#2		28.3%
ground plane		31.8%
metal locker		74.8%
Metal_Aluminum_Anodized		81.7%
SketchUp Default		50.2%
Sophie_Skin		60.5%
wood		60.5%
Wood_Board_Cork		77.6%

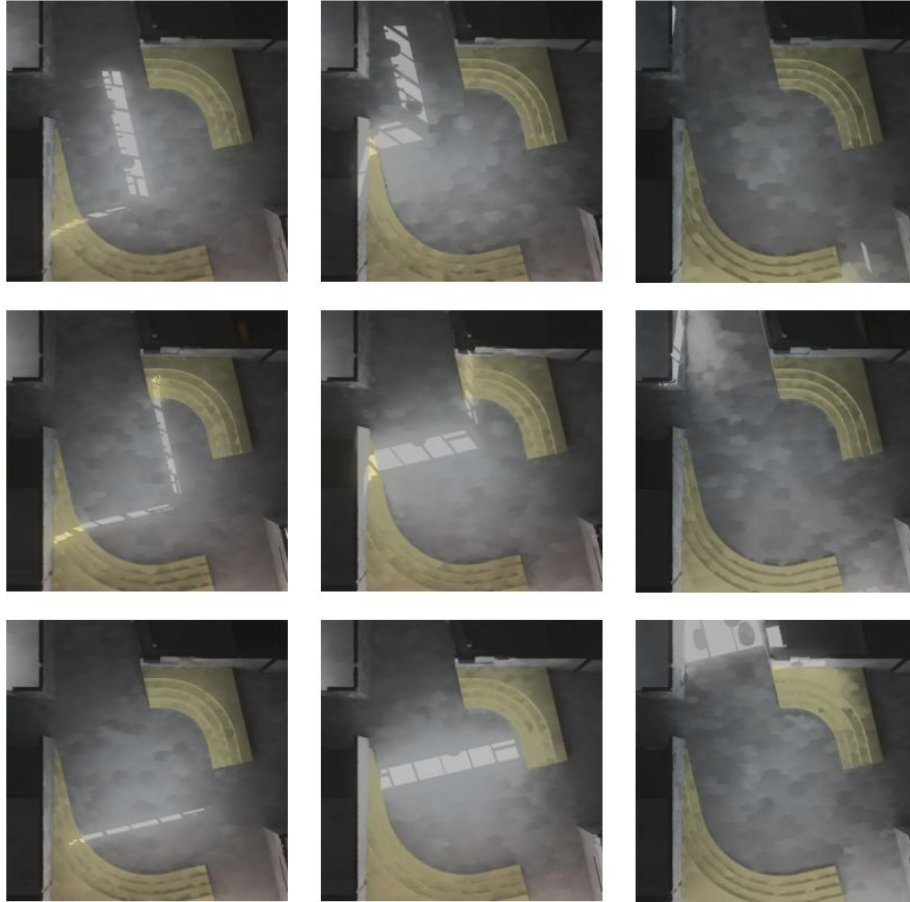
Daylight Product

[+ Create material from scratch](#)

Cunningham Group, Architect of Record

A Complete Picture of Daylight, D. Glaser
Pacific Energy Center, 6/9/2016
Copyright © Light Foundry LLC





Untitled

simple advanced Cancel Save

Materials Window Groups Site Layers Illuminance Grids Viewpoints

Glazing Blinds Details

Multiple materials Properties Generic Custom Manufacturer

Glass ▾ Translucent ▾ Opaque ▾

Cancel Okay

<input type="checkbox"/>	workplane E 90.0 2.4 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane E 90.0 3.0 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane E 90.0 3.4 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane N 0.0 2.4 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane N 0.0 3.4 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane N 0.0 4.1 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane N 0.0 6.7 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic
<input checked="" type="checkbox"/>	workplane N 0.0 6.8 m	Polycarbonate 40% translucent	3% Shade Pewter	Dynamic
<input checked="" type="checkbox"/>	workplane N 0.0 7.0 m	Polycarbonate 40% translucent	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane N 0.0 7.8 m	side monitor	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane N 347.0 7.0 m	side monitor	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 167.0 1.7 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 167.0 2.6 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 167.0 3.2 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 167.0 3.9 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 167.0 6.5 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 167.0 6.8 m	south monitor	3% Shade Pewter	Dynamic
<input checked="" type="checkbox"/>	workplane S 167.0 7.0 m	Polycarbonate 40% translucent	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 180.0 2.1 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 180.0 3.3 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 180.0 6.8 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane S 180.0 7.1 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane W 270.0 2.1 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane W 270.0 2.4 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane W 270.0 3.9 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input checked="" type="checkbox"/>	workplane W 270.0 6.8 m	Polycarbonate 40% translucent	3% Shade Pewter	Dynamic
<input checked="" type="checkbox"/>	workplane W 270.0 7.0 m	Polycarbonate 40% translucent	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane W 275.0 1.6 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane W 275.0 2.1 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane W 275.0 2.8 m	[Translucent_Glass_Tinted]1	3% Shade Pewter	Dynamic
<input type="checkbox"/>	workplane W 275.0 3.3 m	Translucent_Glass_Tinted	3% Shade Pewter	Dynamic

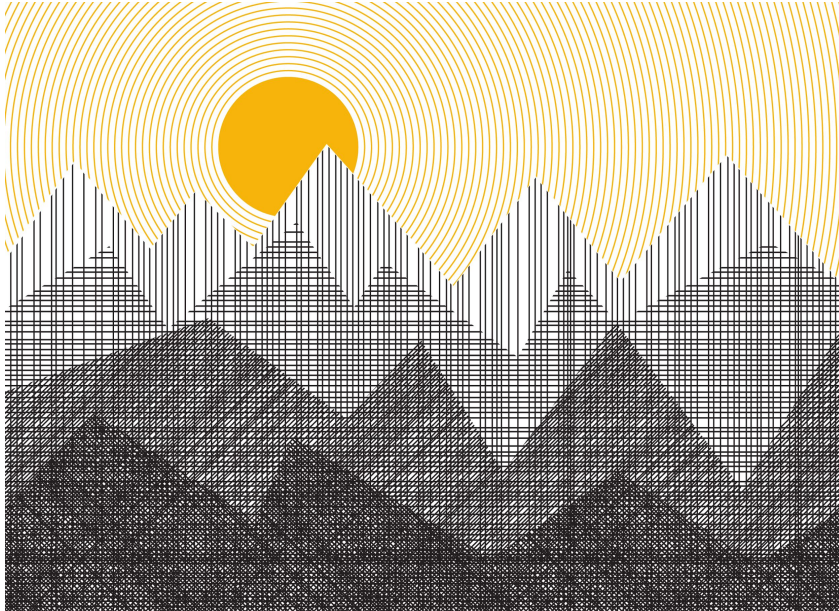


Cunningham Group, Architect of Record



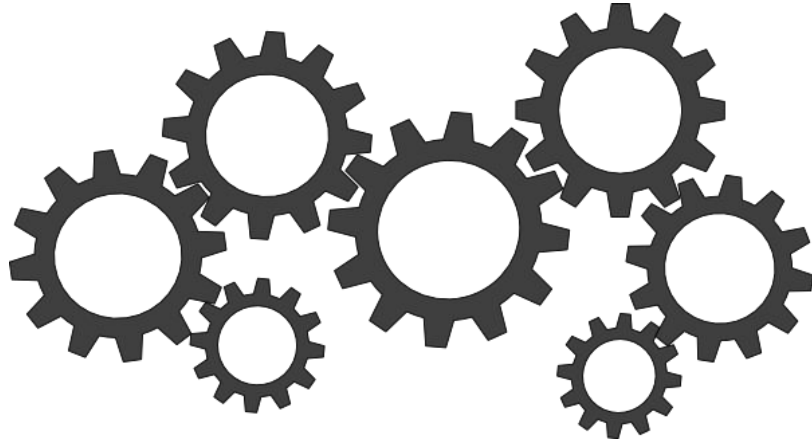
Cunningham Group, Architect of Record

Summary



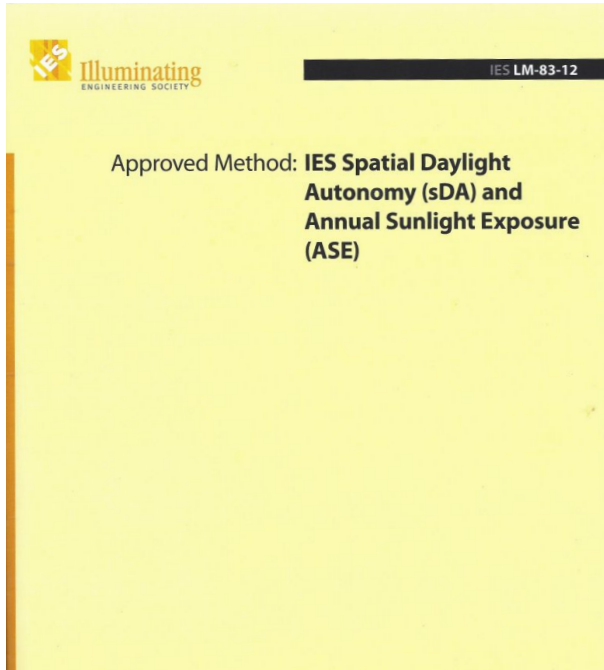
- LEED v2009 vs. LEED v4
- Daylight metrics are complicated, important for LEED v4 Credit
 - ASE, sDA
 - Think beyond the workplane
- Go beyond the workplane!
 - Occupant well-being
 - Point-in-time analysis; false color
 - Glazing, wall thickness, etc.
 - Climate variability

Advanced (But important!)



- Modeling Details
- Grid spacing
- Occupied Spaces
- Window Groups
- 2% Rule

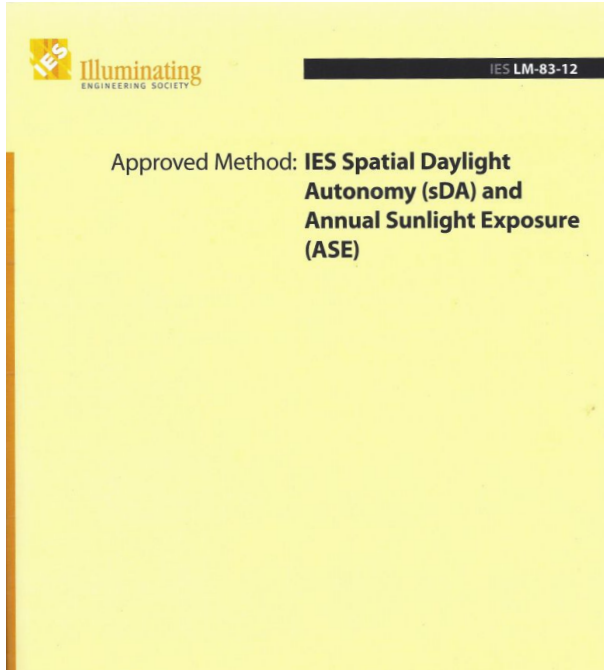
Modeling Details (IES LM-83-12 Excerpts)



2.2.8 Exterior Obstructions Exterior obstructions shall be modeled using at least the minimum level of detail described below.

1. Model all buildings and opaque structures within at least 100' of the spaces under study, including any surfaces of the modeled building itself. Such exterior obstructions shall be modeled with at least a resolution of 10' increments in dimensions.
2. Model trees as appropriately sized cones, spheres, or cylinders with 20% reflective component. More accurate shapes are allowable.

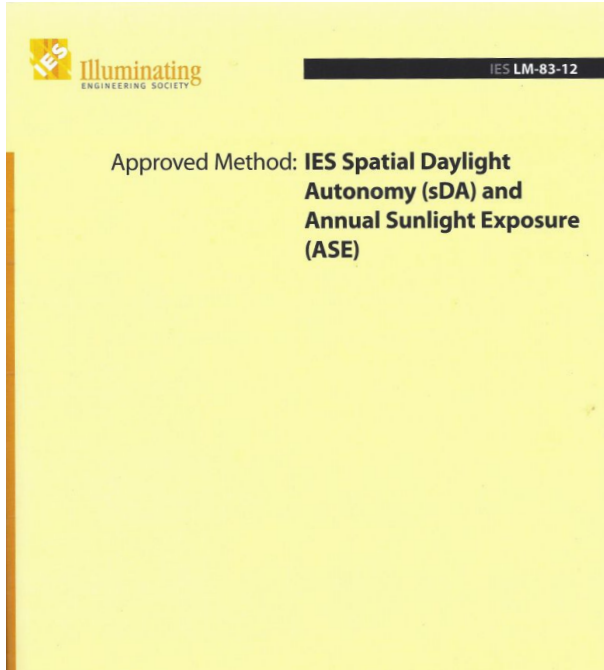
Modeling Details (IES LM-83-12 Excerpts)



2.2.9 Window openings should be modeled in three dimensions, per below.

2. Any window detail (sills, jambs, mullions, etc) greater than 2" in any dimension shall be modeled as such.

Modeling Details (IES LM-83-12 Excerpts)

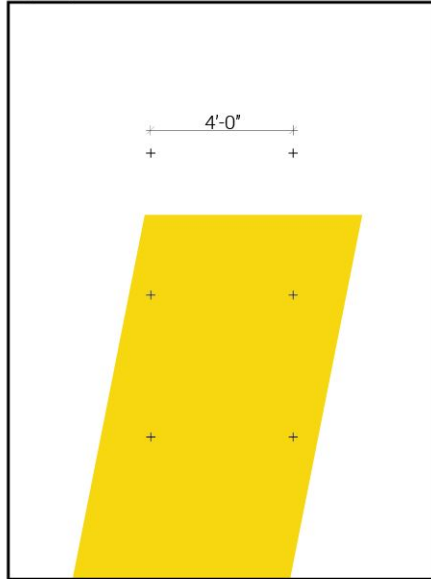


2.2.11 Furniture and Partitions Furniture and opaque interior partitions shall be modeled.

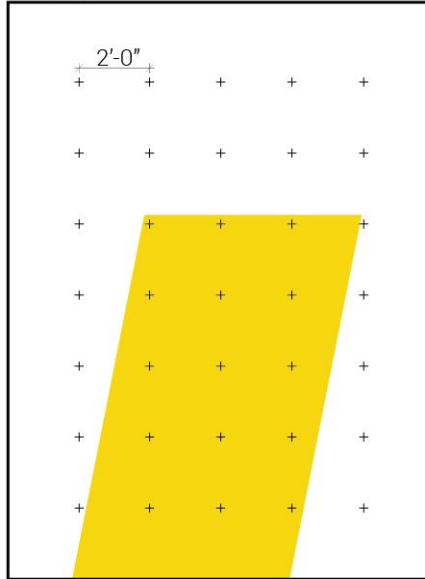
1. Any partition or furniture element extending 36" above the floor or more shall be modeled to within 6" accuracy.

Grid Spacing Matters!

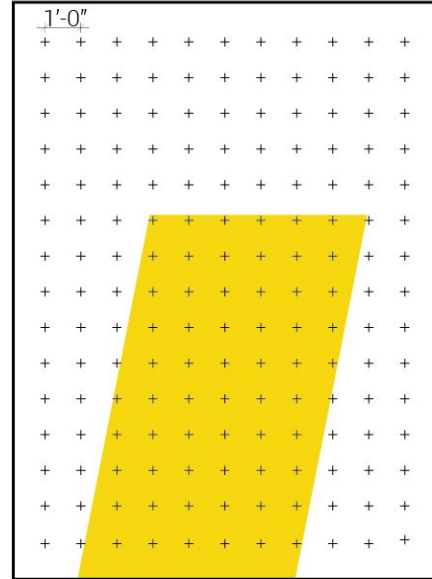
4'-0" point spacing
6 grid points



2'-0" point spacing
35 grid points



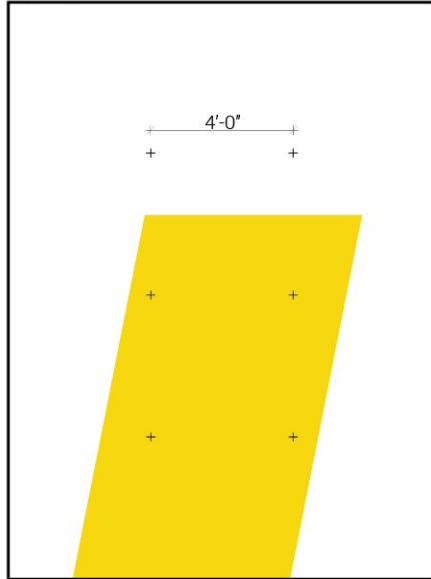
1'-0" point spacing
165 grid points



Grid Spacing Matters!

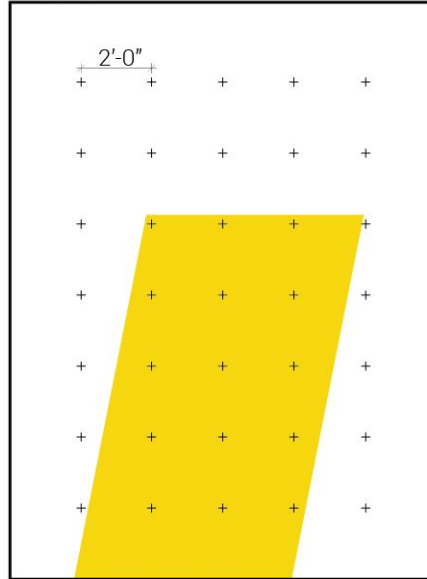
4'-0" point spacing
6 grid points

67%



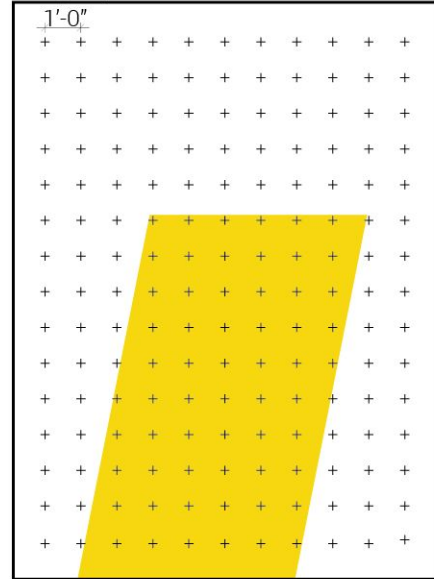
2'-0" point spacing
35 grid points

42%



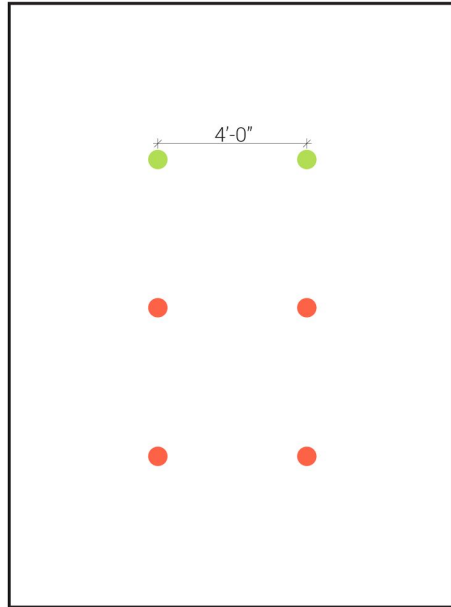
1'-0" point spacing
165 grid points

33%

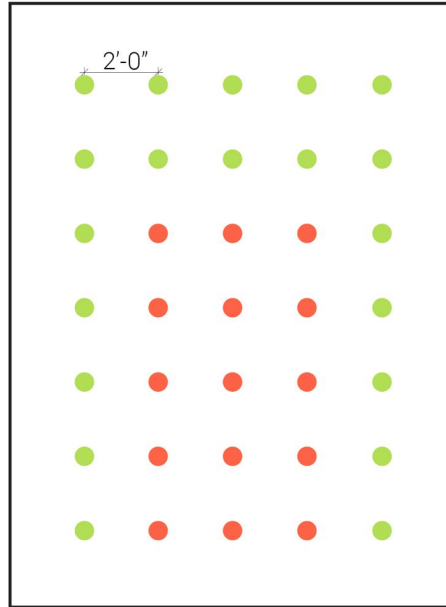


Grid Spacing Matters!

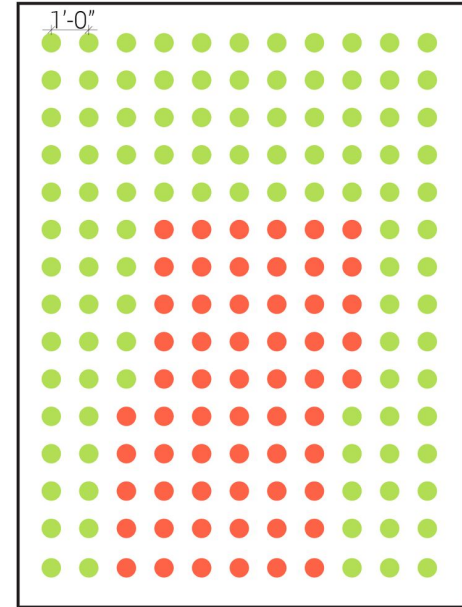
4'-0" point spacing
6 grid points



2'-0" point spacing
35 grid points



1'-0" point spacing
165 grid points



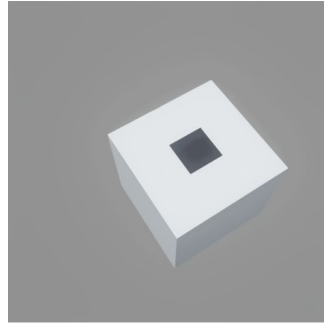
Focus on Workplane in Occupied Spaces



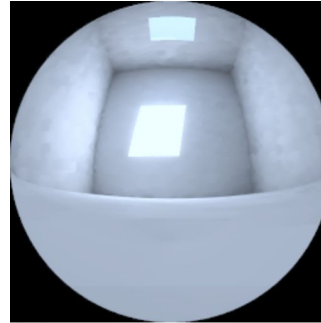
A Complete Picture of Daylight, D. Glaser
Pacific Energy Center, 6/9/2016
Copyright © Light Foundry LLC

Wall/Ceiling Thickness, Skylights

< 1in ceiling thickness
3x3 foot skylight



June 21, 03:00 PM

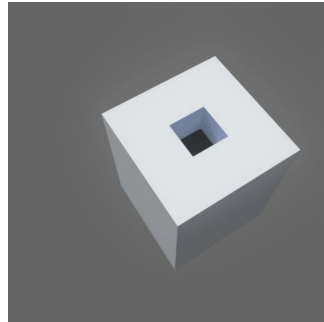


June 21, 03:00 PM

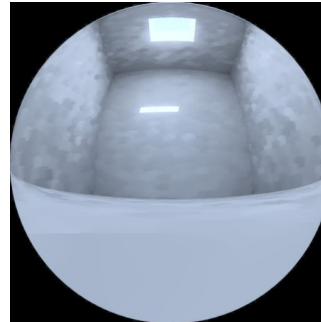


June 21, 03:00 PM

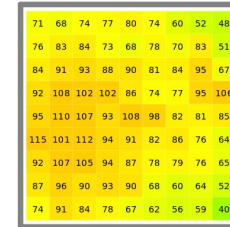
3ft ceiling thickness
3x3 foot skylight



June 21, 03:00 PM



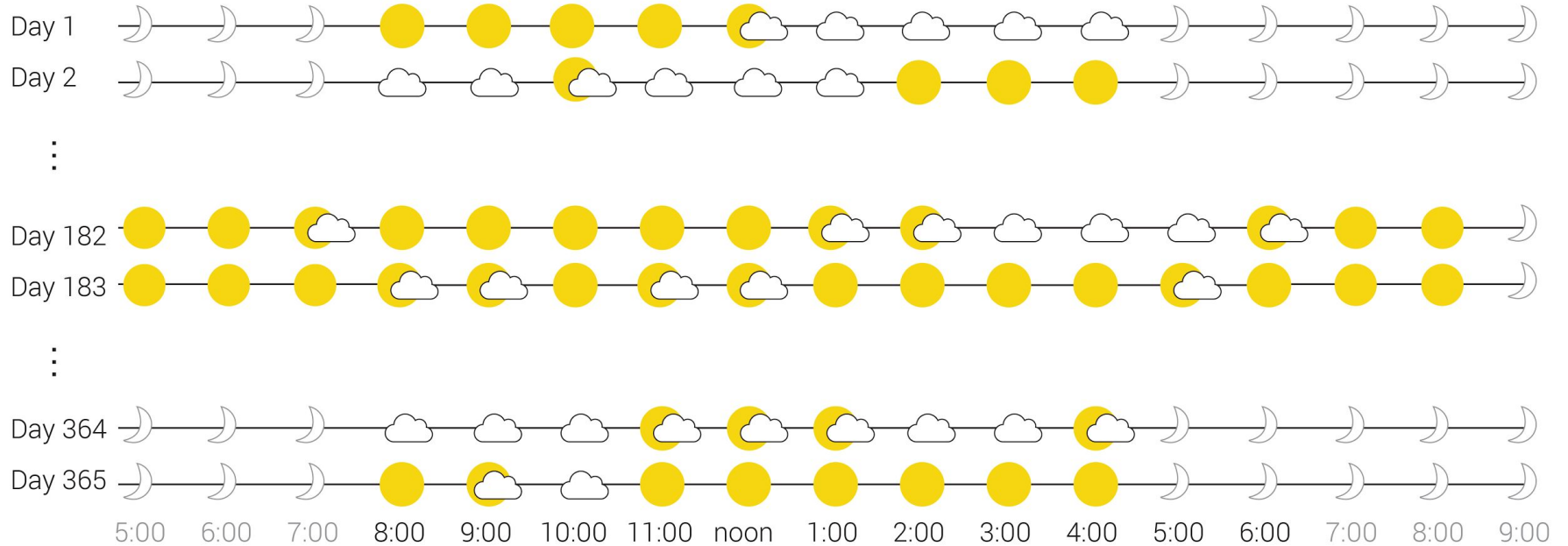
June 21, 03:00 PM



June 21, 03:00 PM

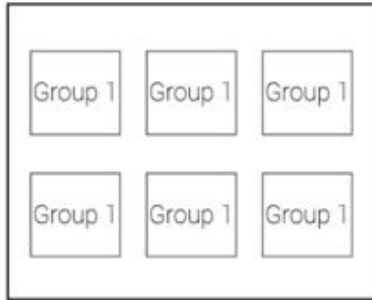
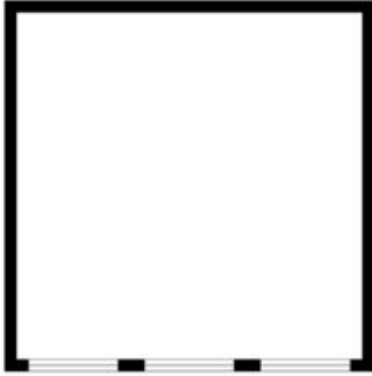
A Complete Picture of Daylight, D. Glaser
Pacific Energy Center, 6/9/2016
Copyright © Light Foundry LLC

Climate Variability

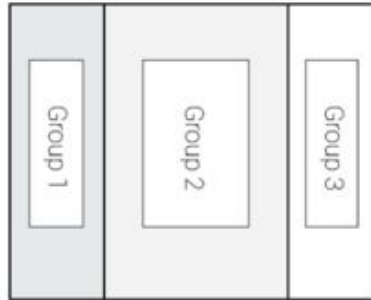
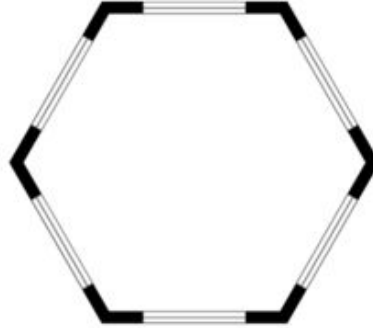


Window Groups

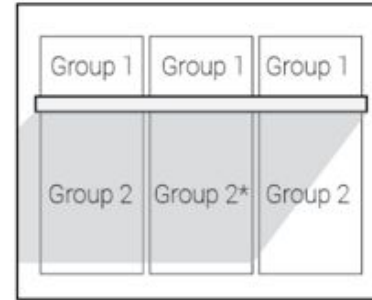
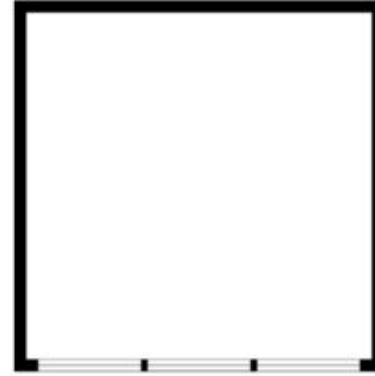
A



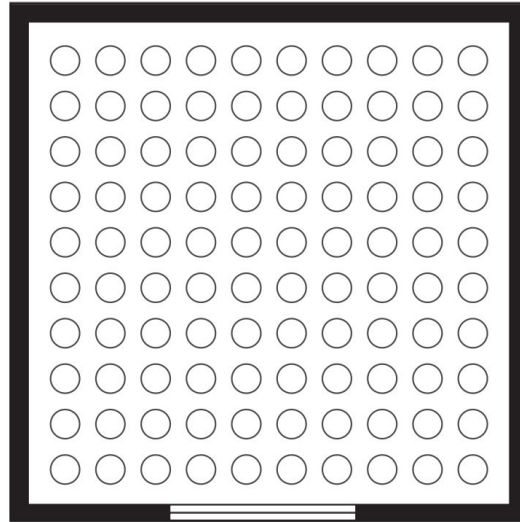
B



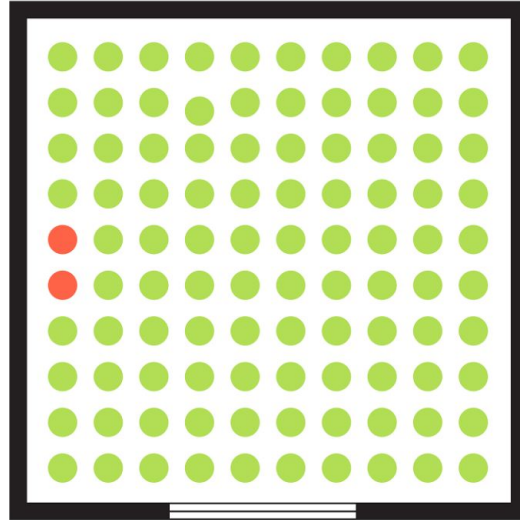
C



Example: Illuminance Grid with 100 Grid Points and 1 Window



2% Rule: Blinds Stay Open

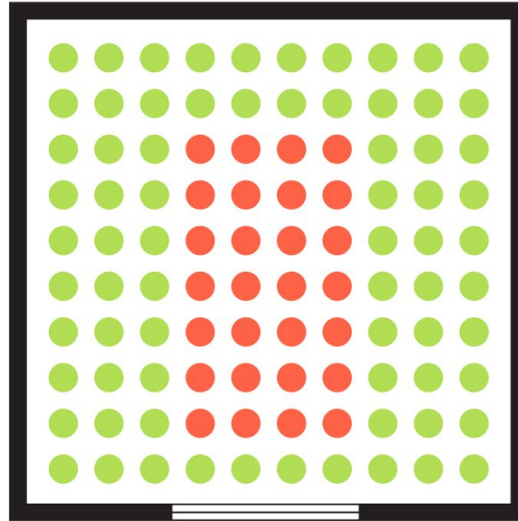


Dec 21st at 10:00 a.m.

Blinds open

2%

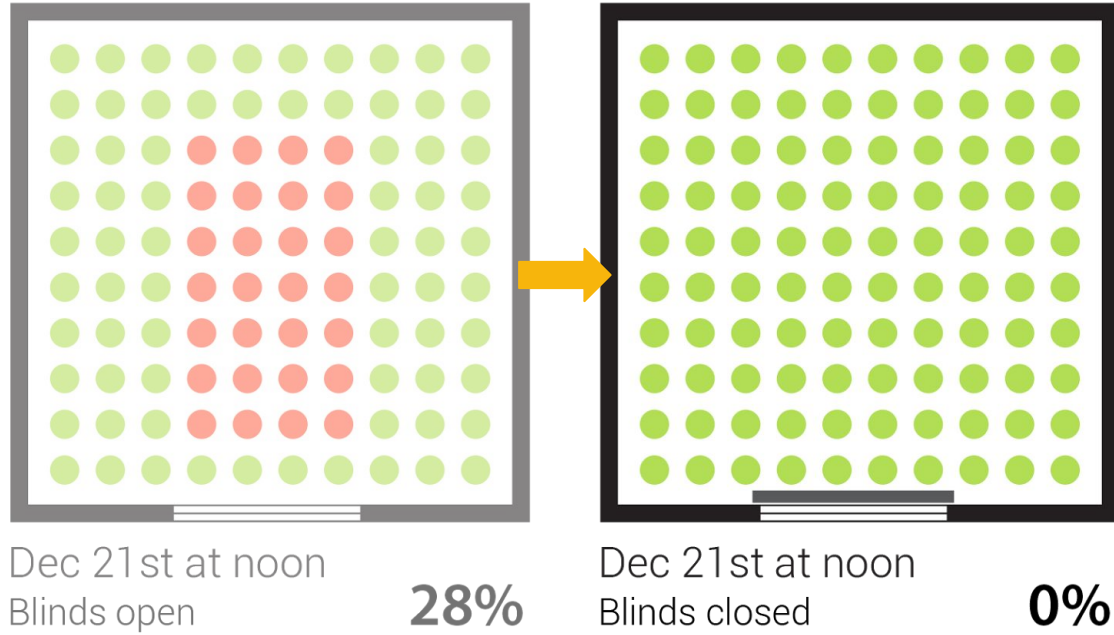
2% Rule: Exceeding 2% Direct Sunlight Before Blinds Operate



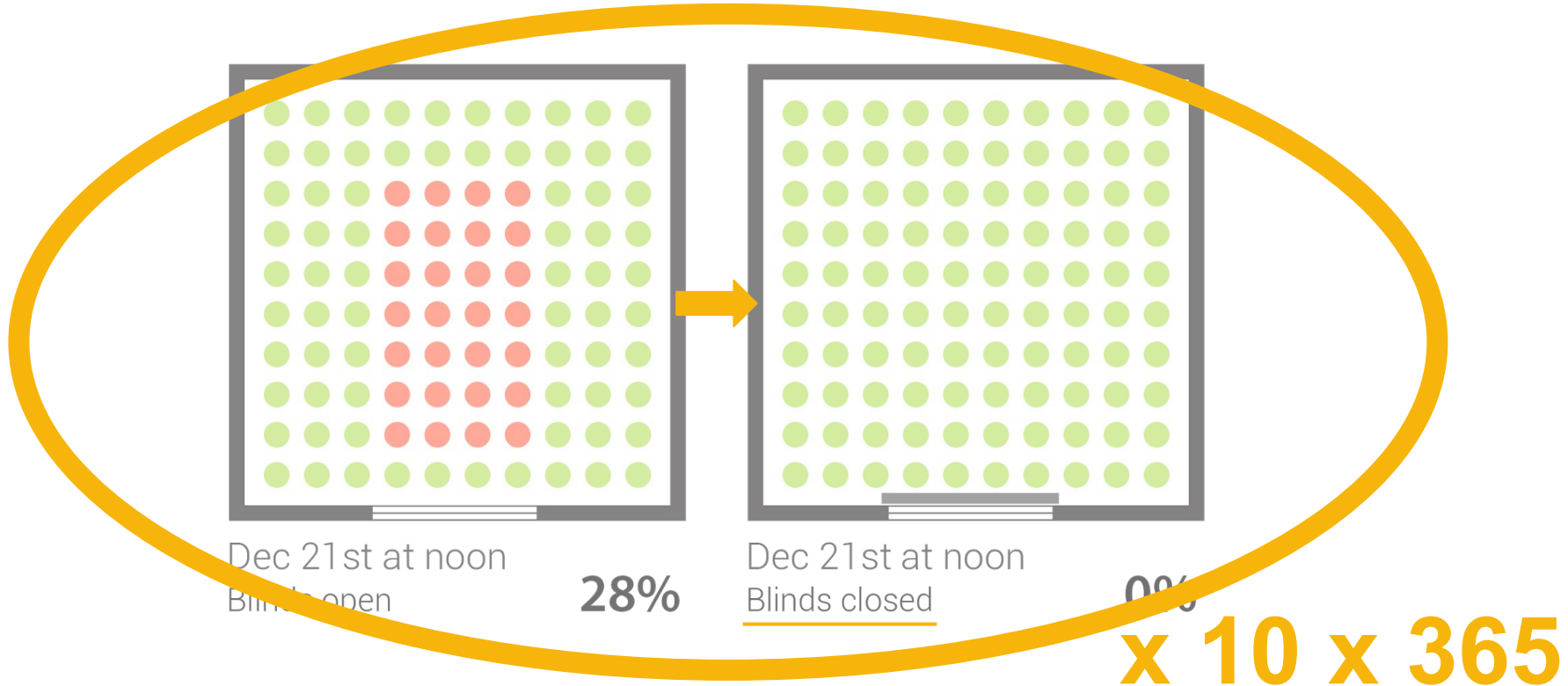
Dec 21 st at noon
Blinds open

28%

2% Rule: Blinds Close

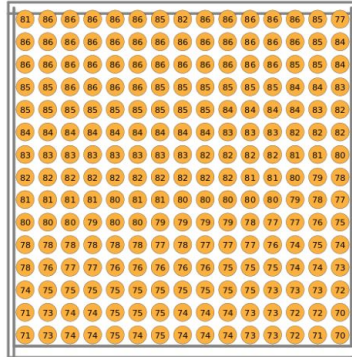


Blinds Operate for 1 Year



Daylight Metrics In-Class Exercise

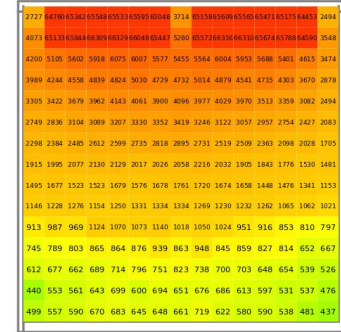
Classroom Model with
Blinds NOT Operating:



sDA: 100.00%

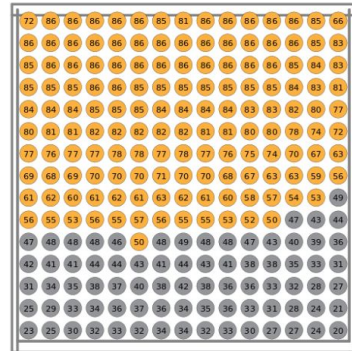


September 21, 12:00 PM



September 21, 12:00 PM

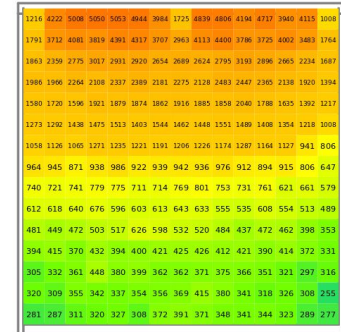
Classroom Model with
Blinds Operating:



sDA: 64.89%



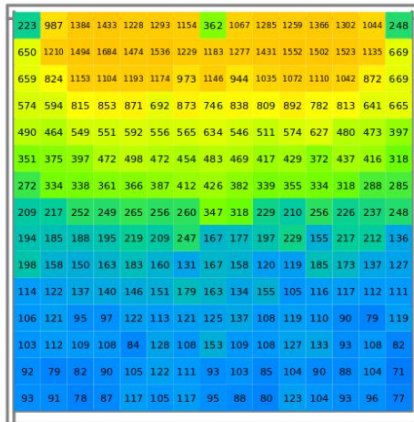
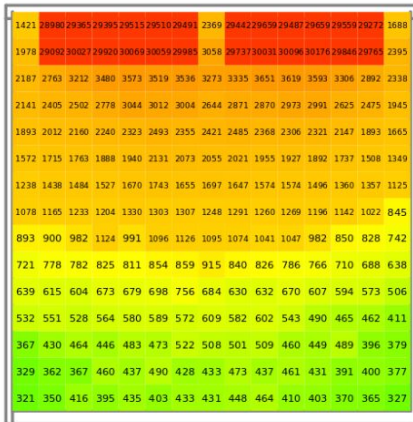
September 21, 12:00 PM




September 21, 12:00 PM

A Complete Picture of Daylight, D. Glaser
Pacific Energy Center, 6/9/2016
Copyright © Light Foundry LLC

Classroom Model with Blinds NOT Operating:



Classroom Model with Blinds NOT Operating:




1421	1886	2885	2985	2985	2985	2045	2369	2842	2969	2948	2968	2959	2927	1488
1978	2995	3007	2990	3069	3095	2998	3058	2973	3003	3098	3076	2886	2975	2395
2187	2761	3212	3480	3573	3519	3536	3273	3335	3651	3619	3583	3306	2892	2338
2141	2405	2502	2778	3044	3012	3004	2644	2871	2870	2973	2991	2625	2475	1945
1893	2012	2160	2240	2323	2493	2355	2421	2485	2368	2306	2321	2147	1893	1665
1572	1715	1783	1888	1940	2131	2073	2055	2021	1955	1927	1892	1737	1508	1349
1238	1438	1484	1527	1670	1743	1655	1697	1647	1574	1574	1496	1360	1257	1125
1078	1165	1233	1204	1330	1303	1307	1248	1291	1260	1269	1196	1142	1022	845
893	900	982	1124	991	1096	1126	1095	1074	1041	1047	982	850	828	742
721	778	782	825	811	854	859	915	840	826	786	766	710	680	638
639	615	604	673	679	698	756	684	630	632	670	607	594	573	506
532	551	528	564	580	589	572	609	582	602	543	490	465	462	411
367	430	464	446	483	473	522	508	501	509	460	449	409	396	379
329	362	367	460	437	490	428	433	473	437	461	431	391	400	377
321	350	416	395	435	403	433	431	448	464	410	403	370	365	327

723	987	1384	1433	1228	1293	1514	362	1067	1285	1259	1366	1302	1044	748
650	1210	1494	1684	1474	1536	1229	1183	1277	1431	1552	1502	1523	1135	669
659	824	1153	1104	1191	1174	973	1146	944	1035	1072	1110	1042	872	669
574	594	815	853	871	692	873	746	838	809	892	782	813	641	665
490	464	549	551	592	556	565	634	546	511	574	627	480	473	397
351	375	397	472	498	472	454	483	469	417	429	372	437	416	318
272	334	338	361	366	387	412	426	382	339	355	334	318	288	285
209	217	252	249	265	256	260	347	318	229	210	256	226	237	248
194	185	188	195	219	209	247	167	177	197	229	155	217	212	136
198	158	150	183	183	160	131	167	158	120	119	185	137	137	127
114	122	137	140	146	151	179	163	134	155	105	116	117	112	111
106	121	95	97	122	113	121	125	137	108	119	110	90	78	119
103	112	109	108	84	128	108	153	109	108	127	133	93	108	82
92	79	82	90	105	122	111	93	103	85	104	90	88	104	71
93	91	78	87	117	105	117	95	88	80	123	104	93	96	77

291	669	836	992	1066	3065	1246	514	768	1067	1075	1383	1574	1797	903
523	867	1294	4018	4107	4189	4051	8834	1310	1576	4310	4565	4803	4757	5331
544	756	986	1198	3910	4050	4044	4143	3777	1918	1709	4382	4367	5013	5734
592	659	806	1199	1217	3750	3929	3645	3826	3826	3797	1784	4543	5160	9895
543	633	646	693	907	1179	3093	3708	3953	3950	3732	4175	1821	4774	5691
463	535	502	772	749	804	926	3353	3400	3697	3751	3921	3821	1812	5857
410	461	436	475	581	605	645	910	8135	6405	6388	8056	6766	6900	3836
411	400	414	455	488	579	618	624	648	6488	6449	6393	6338	6476	8833
305	309	352	379	509	554	525	539	614	630	778	8416	854	8303	927
268	271	273	242	364	402	437	462	566	576	664	689	723	766	714
282	242	244	240	271	304	338	414	439	474	639	589	632	524	512
256	200	214	311	337	343	356	341	380	523	414	424	498	492	500
193	204	200	224	249	268	268	297	305	406	460	397	392	506	473
204	162	170	388	227	257	277	293	310	452	390	414	448	462	426
194	155	167	173	210	219	232	273	349	396	438	415	418	412	386

Classroom Model with Blinds Operating:



917	2291	2712	2489	2850	2811	2895	1569	2319	2638	3135	2948	3021	2840	920
1386	1897	2820	3281	3044	2698	3108	2237	2612	3064	2918	3073	3022	2516	1357
1459	1858	2297	2513	2568	2559	2299	2292	2182	2423	2498	2468	2238	1885	1426
1427	1515	1731	2015	2110	1870	1801	1712	1998	1831	1795	1757	1564	1500	1215
1188	1305	1352	1577	1490	1441	1505	1496	1430	1487	1473	1476	1272	1302	1026
1072	1075	1081	1208	1072	1108	1133	1160	1168	1172	1221	1062	1061	922	867
869	906	966	961	998	950	1021	967	1007	971	910	873	803	718	651
685	725	713	757	793	847	760	750	778	769	733	723	694	627	543
488	574	554	624	579	585	619	625	628	608	581	548	517	471	415
444	438	470	485	501	543	509	498	459	449	485	398	481	374	418
380	387	381	413	426	432	450	460	393	461	390	456	362	376	319
330	305	331	313	318	322	358	348	329	314	302	353	298	289	276
257	281	288	280	278	292	291	288	312	288	281	263	264	235	230
221	231	252	293	262	272	275	277	283	271	269	280	248	239	225
218	235	233	244	237	277	286	276	268	261	254	257	262	246	211

256	1128	1296	1349	1403	1278	1092	356	1068	1296	1340	1360	1296	1135	231
638	1086	1445	1613	1568	1532	1355	1035	1275	1305	1748	1524	1424	1188	718
571	861	1087	1147	1122	1217	1102	1157	1016	1108	1174	1201	1060	853	716
576	663	716	1001	810	986	753	771	818	780	827	816	765	651	509
443	468	557	472	447	486	628	675	650	570	652	546	492	459	349
416	397	424	452	374	405	386	401	428	379	410	414	388	354	273
302	304	314	355	348	363	370	433	425	272	322	375	284	265	222
211	220	224	251	276	256	272	274	276	202	305	208	215	233	146
213	208	158	167	175	183	171	186	220	172	160	163	240	173	173
185	158	160	199	150	186	167	164	139	143	132	179	172	128	125
156	123	125	150	115	156	112	113	133	128	135	109	112	127	112
114	99	101	105	115	106	183	123	123	152	123	120	115	82	102
78	94	80	102	104	109	158	100	119	115	98	105	96	100	91
87	91	83	109	116	112	146	101	90	100	90	90	86	75	96
94	80	86	120	120	94	101	108	120	115	110	95	94	76	90

167	418	484	507	568	591	530	261	488	534	578	539	515	461	155
287	443	519	547	596	583	522	558	503	552	572	636	602	473	468
263	323	383	403	464	529	460	387	380	521	430	495	476	483	388
238	260	318	310	311	362	389	382	370	399	338	352	336	308	322
187	227	211	234	255	260	299	256	225	361	333	302	273	251	294
177	162	164	182	188	198	188	193	210	207	326	313	227	202	193
123	152	160	150	157	162	148	151	164	154	188	176	158	153	141
111	122	120	117	130	103	129	127	123	127	128	115	193	180	210
89	106	72	73	86	87	83	83	87	80	89	161	86	118	79
68	75	69	71	72	72	74	82	70	70	66	94	80	66	107
56	57	57	55	57	58	60	52	52	65	60	59	62	57	62
48	51	47	48	51	55	56	53	52	57	58	51	90	56	70
44	41	41	50	40	41	39	40	46	50	49	40	50	52	42
36	53	38	38	39	39	39	46	50	43	48	40	47	42	38
34	36	37	36	47	45	38	55	45	41	50	38	44	43	41

Daylight Metrics In-Class Exercise

Design A

- Clear Glass (90% VLT) Windows
- Windows facing S



September 21, 12:00 PM

Design B

- Clear Glass (90% VLT) Windows
- Windows facing NW



September 21, 12:00 PM

Classroom facing NW

Materials Window Groups Site Layers Illuminance Grids Viewpoints

- Custom Material 91.8%
- Glass 50% 45.9%

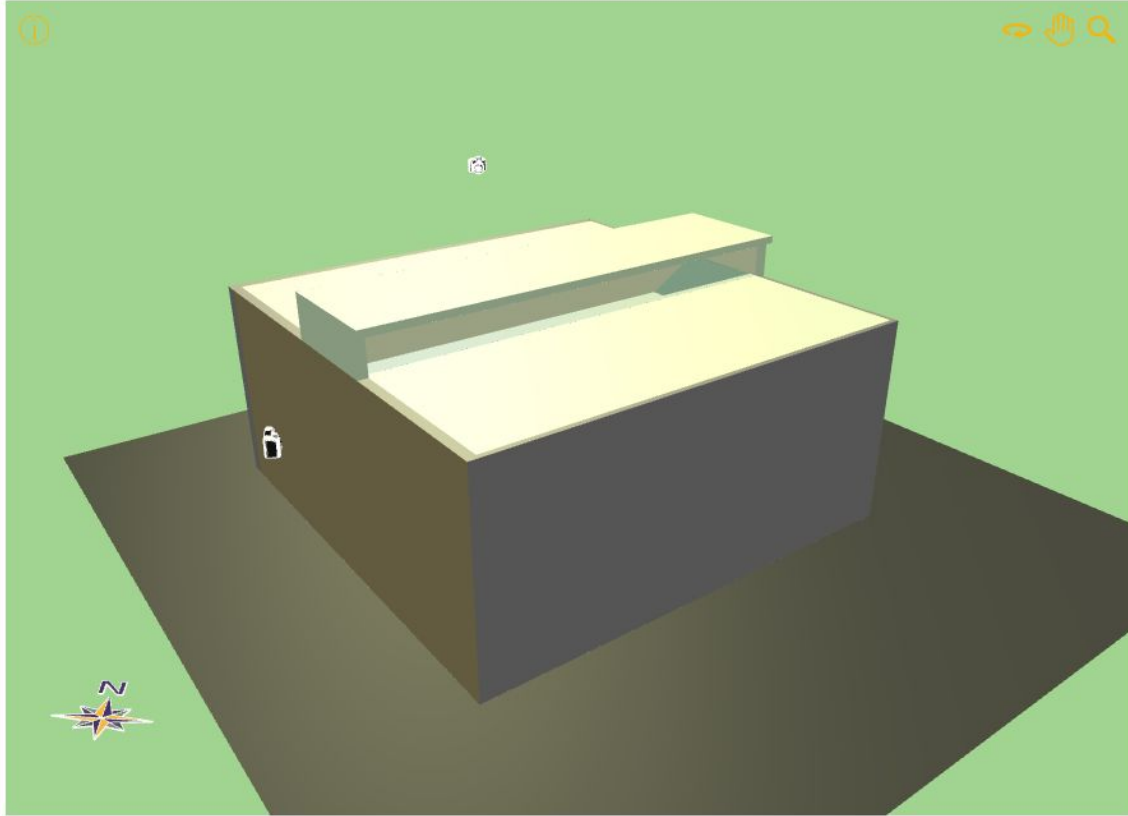
Translucent

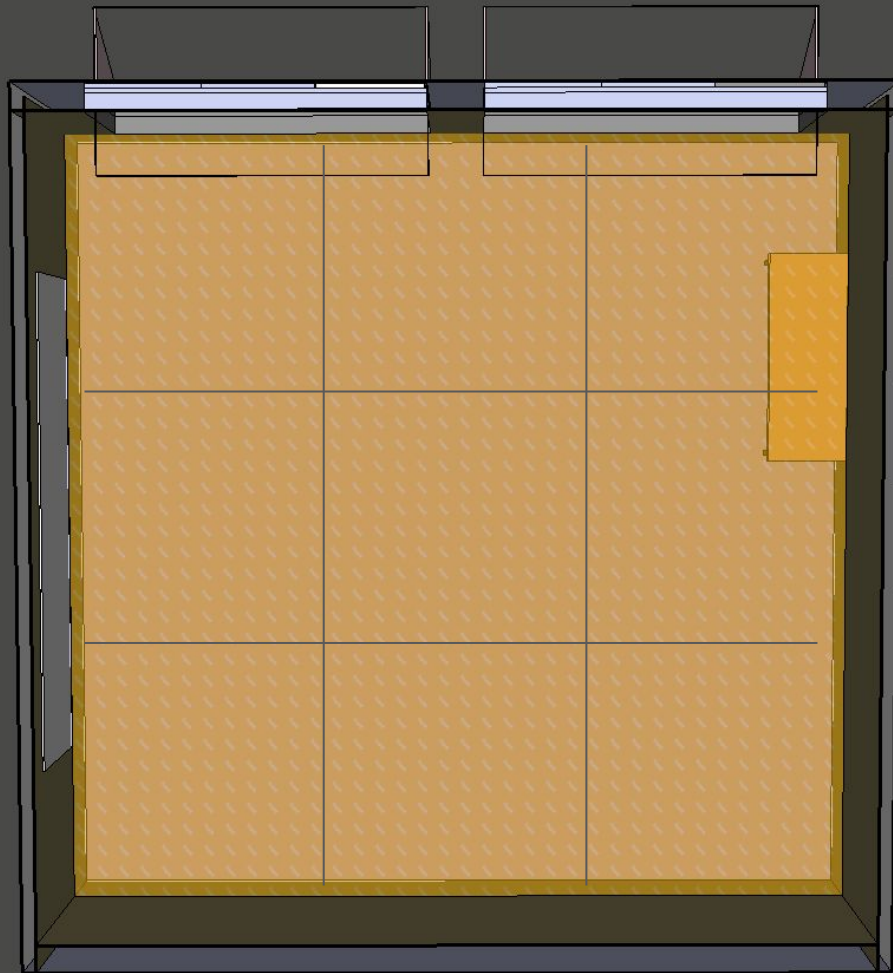
Material	Properties
	DT ST DR SR A RA

Opaque

Material	Properties
	Color Ref.
<input type="checkbox"/> Ceiling	86.6%
<input type="checkbox"/> Exterior Shelf	80.1%
<input type="checkbox"/> floor	47.0%
<input type="checkbox"/> Ground Plane	23.9%
<input type="checkbox"/> Light Shelf	78.7%
<input type="checkbox"/> Mullions and Sill	49.8%
<input type="checkbox"/> Side Shade	74.4%
<input type="checkbox"/> SketchUp Default	50.2%
<input type="checkbox"/> Skylight_Sides	93.6%
<input type="checkbox"/> Walls	53.3%
<input type="checkbox"/> White Board	94.1%
<input type="checkbox"/> Wood - Door and Desk	46.4%







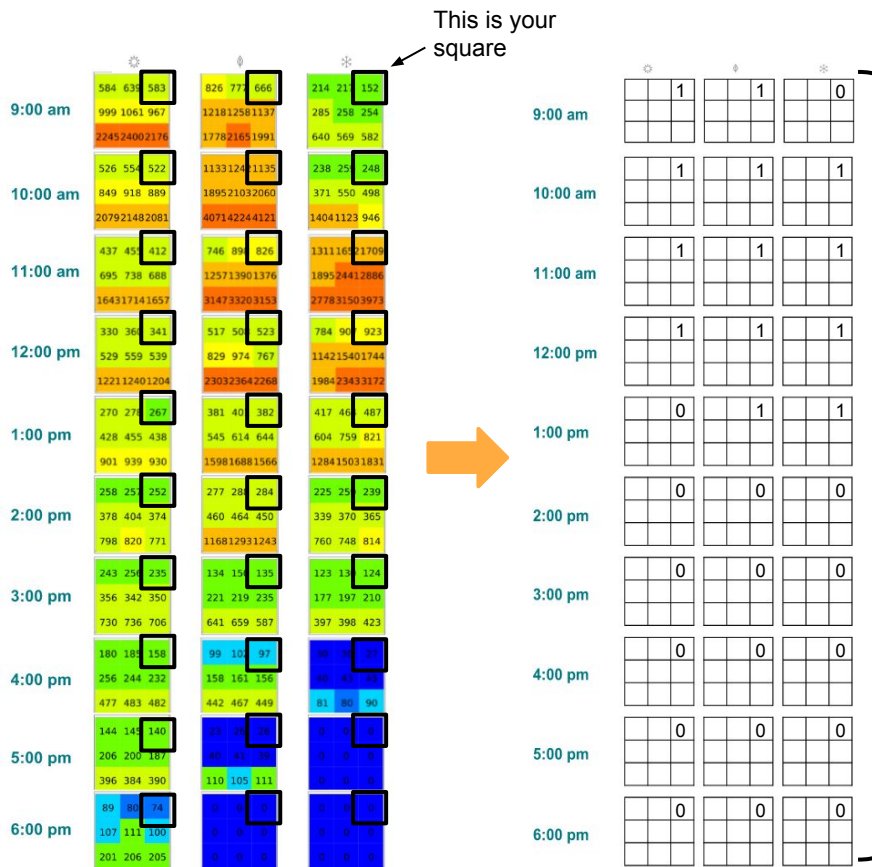


Daylight Metrics In-Class Exercise

Directions:

- Get into groups of 2-3
- Get assigned an individual square (grid point) in the 3x3 grid
- At each square (for all 30 of the timepoints in the handout) determine whether or not the value is above/equal to or below the threshold of 300
 - If above/equal to 300, mark as 1
 - If below 300, mark as 0
- Total your 1's and write down a final score (between 0 and 30) in the last row of empty grids
- After your final score is computed, divide by 30 and write this percent
 - If this % is ≥ 50 , give your square a **PASS**
 - If this % is < 50 give your square a **NO PASS**

For Example:



1. Total your individual squares (All 3 seasons): 13
2. Divide total in (1) by 30: $13 / 30 = 0.43$
3. Multiply answer in (2) by 10: 43 % $\geq 50\%$ PASS: <50% NO PASS

Artifacts

S-Facing 12:00pm September 21st



September 21, 12:00 PM

NW-Facing 6:00pm June 21st



June 21, 06:00 PM

Final LEED v4 Score: Design A=100%=3 credits

83%*	87%*	80%*
77%*	67%*	67%*
63%*	63%*	57%*

Total Passed:

Total Squares:

(total passed) / (total squares):

≥55% - 2 LEED v4 points

≥75% - 3 LEED v4 points

Final LEED v4 Score: Design B=67%=2 credits

83%*	83%*	83%*
70%*	77%*	73%*
33%	43%	30%

Total Passed:

Total Squares:

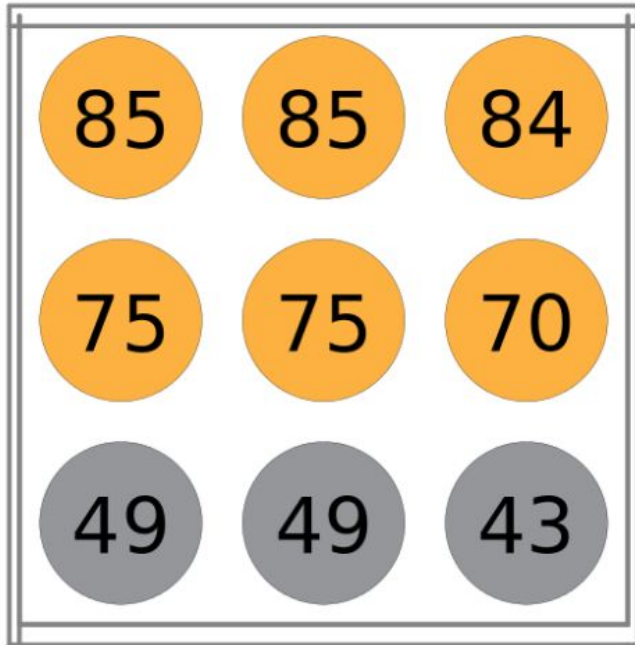
(total passed) / (total squares):

≥55% - 2 LEED v4 points

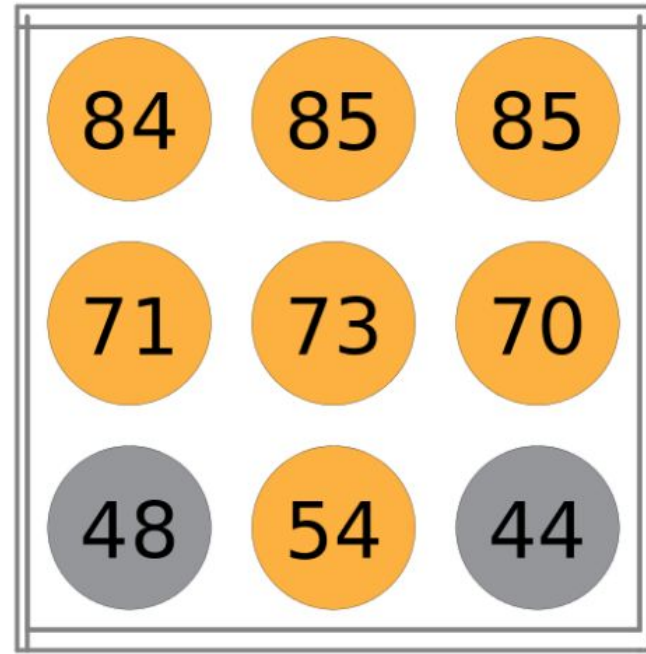
≥75% - 3 LEED v4 points

Actual sDA scores for Designs A and B

Design A (Windows Facing S) 66.7%

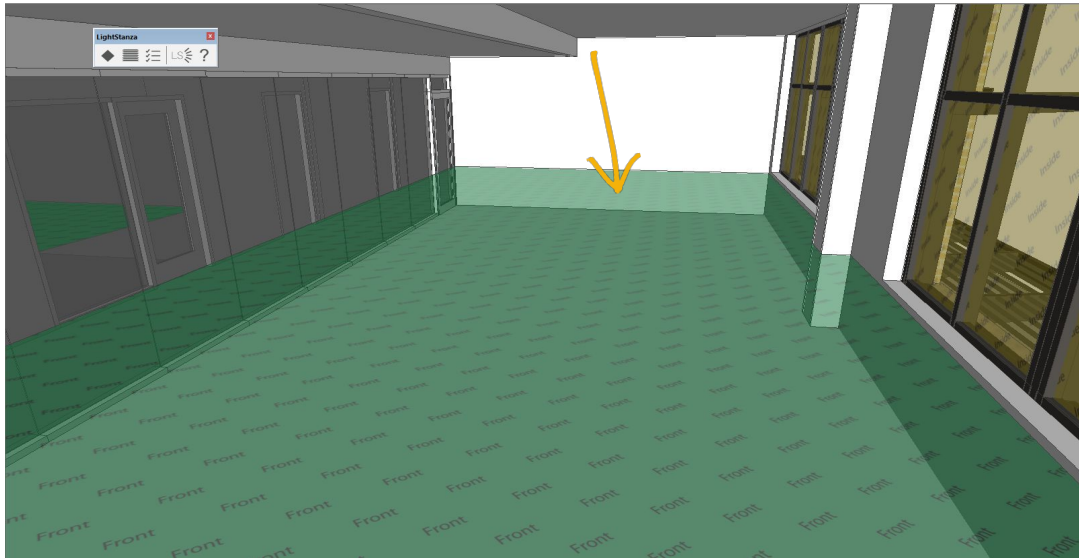


Design B (Windows Facing NW) 77.8%

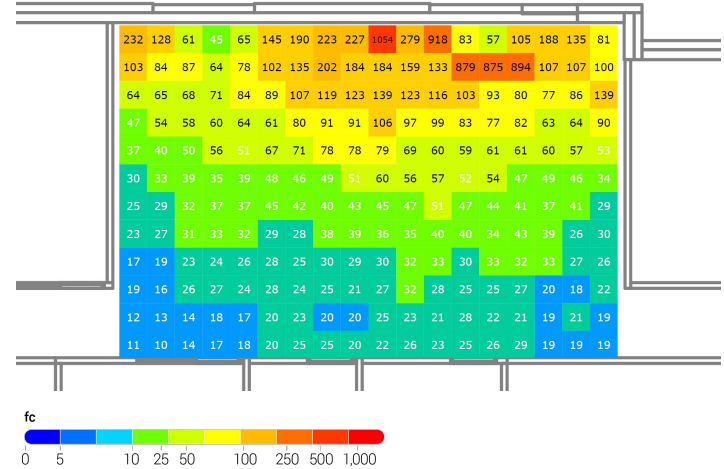


Demo

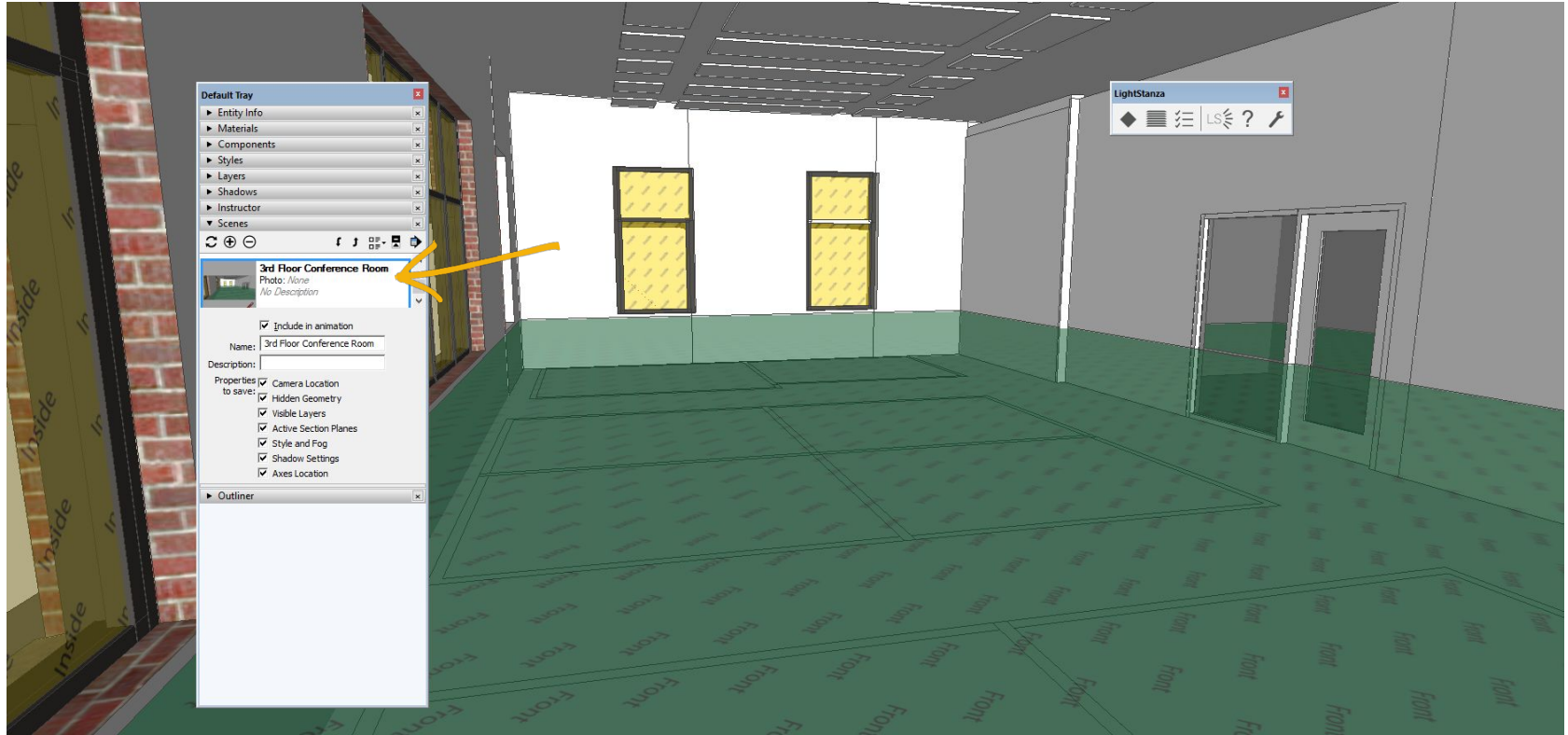
Create Illuminance Grids in SketchUp



Model Design by RNL Design



Create Viewpoints in SketchUp




A Complete Picture of Daylight, D. Glaser
Pacific Energy Center, 6/9/2016
Copyright © Light Foundry LLC

Questions/Comments?


Contact Us!

Daniel Glaser

 (720) 722.0771

 daniel@lightstanza.com

LightStanza Support

 (720) 722.0771

 support@lightstanza.com

A **free 3-month subscription** to LightStanza Professional is available to all attendees of the seminar!

Please go to the link below to apply for a free account:

<http://my.lightstanza.com/#/signup>