# A POST-OCCUPANCY DAYLIGHT ANALYSIS: VERNONIA K-12 SCHOOL

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**1 INTRODUCTION** 

Daylight is an important aspect of design, specifically in school settings. Daylight is not only desirable but crucial for the growth of children, including: increased connection to nature, reduced electricity bills, and increased attention spans. Recent studies have shown the positive relationship between diffuse daylight and student performance (Melton, 2012). The proper design of daylight can enhance a space without electric light. The main goals of daylighting are (1) control direct light during occupied hours (2) provide balanced illuminance on interior surfaces (3) provide sufficient ambient daylight illumination for visual tasks (Pattern Guide for Advanced Daylight, 2014). This research is focused on comparing one digital software program; Autodesk 3ds Max, with field measurements with the aim to inform future projects to integrate daylight analysis as a critical factor in design decisions.

#### 2 METHODOLOGY

The aim of this workflow was to provide insight into the daylight relationship between digital software, AutoDesk 3ds Max, and field measurements. Digital software has been used to analyze daylight for many years, however, its integration into the design process has wavered throughout firms. There has been a challenge with integrating daylight analysis iterations into the early design process where it could inform design decisions. It was the intention of this daylight post-occupancy study to provide understanding of the daylight software's ability to accurately output real life numbers.

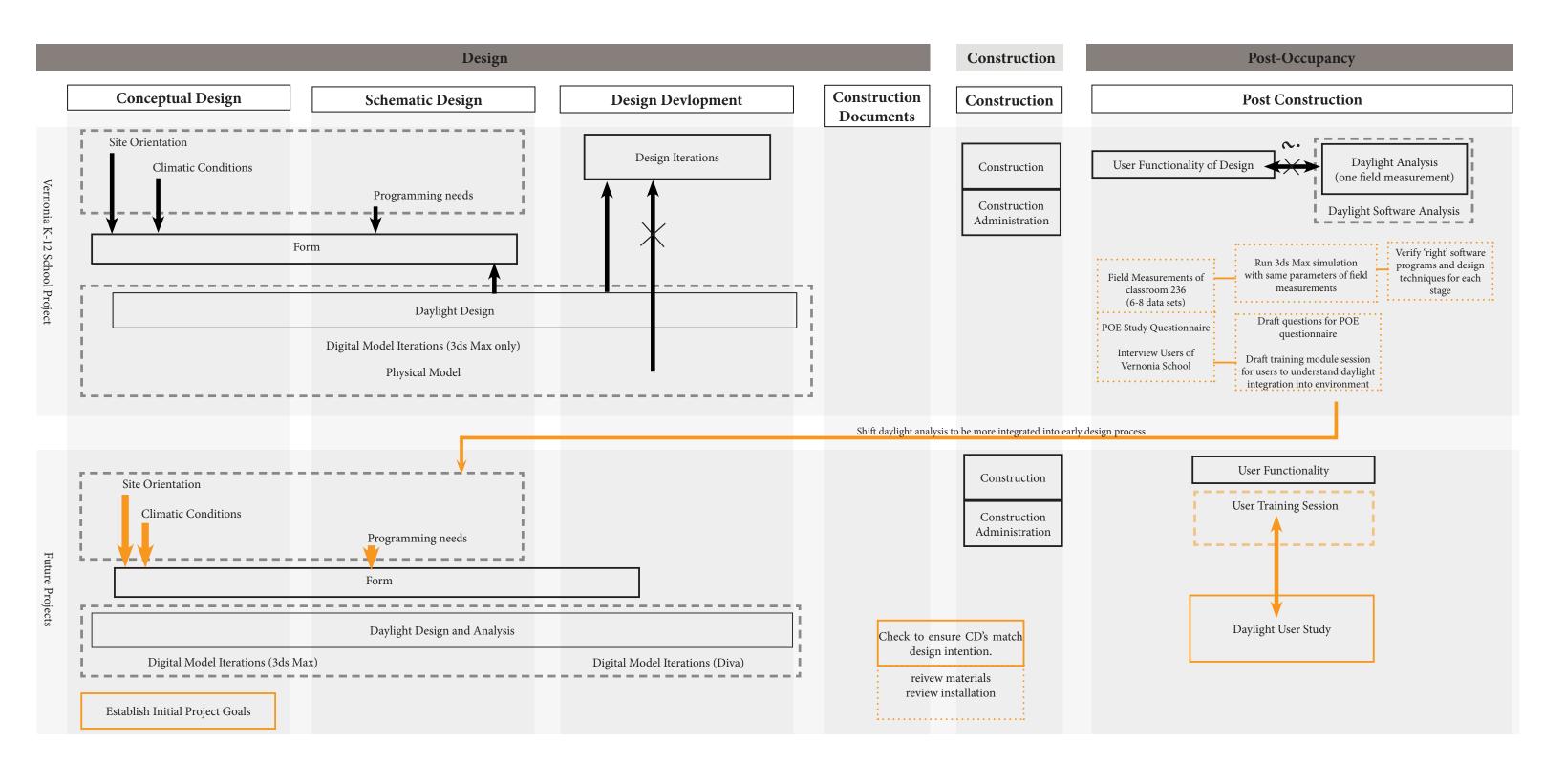
The room was left in its existing state except for raising all the blinds to calculate for optimum daylight from the design strategies used. There were no electric lights on through the duration of gathering field measurements. The measurements were taken using footcandles (fc), along a four foot grid throughout the classroom. Seven data sets were taken using a General Tools Instrument DLM1337 Digital Light Meter on January 26, 2014 between 12:00pm and 3:00pm on an unusually clear sky day. It is important to note that these conditions do not represent a typical day in Vernonia, Oregon. According to the National Weather Service Vernonia, Oregon in the typical January experiences nineteen cloudy days, seven partly cloudy days, seven fair days, and seven average cloud cover days. The average relative humidity is seventy-eight percent. (National Weather Service, 2013).

## 3 DATA

The data reveals a large margin of error between the digital simulation and the field data. Major influences of this difference can be seen in the material representation and sky conditions. AutoDesk 3ds Max is dependent on the RGB (red green blue) value code from Revit to calculate surface reflectance. This value is not an accurate representation of the material. It can be compared to the surface reflectance measurements taken using the Reflectometer Vis 410 Instrument. According to Breton & Laundry, the material can cause a margin of error up to twenty-five percent. To put this into understandable terms, this margin of error is the difference between a well lit space and a dark room.

## 4 CONCLUSIONS

As more research is being done with post-occupancy conditions and daylight design, it is important to gain knowledge on the transition from design intention to occupant use. Software is becoming more accurate and new software features, such as the daylight tool in Revit, are being developed in help integrate daylight design into the early design process. This research begins to find ways in which daylight can become more integrated in an informative design process. As technology and the importance of daylight as an informing design factor grows, the industry will develop more accurate tools that fall into the natural workflow of design professionals.



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	233	180	134	102	140	150	80
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-	142	143	141	111	121	149	255
	151	165	190	123	154	211	214
1	260	396	205	135	171	428	439
	248	370	183	83	144	395	570
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76	113	89	110	124	77	87
135	95	151	126	139	128	103
189	192	180	224	234	192	198
194	236	246	264	215	244	274
335	2481	2537	255	304	350	2521
413	368	353	299	296	452	532
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	75	103	76	86	86	38	79
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	341	314	268	268	287	415	531
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	387	2285	387	285	296	2421	828
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The current disconnection from design intention to user occupancy needs to be improved to maximize daily use of daylight in the classroom environment.

# PORTLAND STATE UNIVERSITY SCHOOL OF ARCHITECTURE



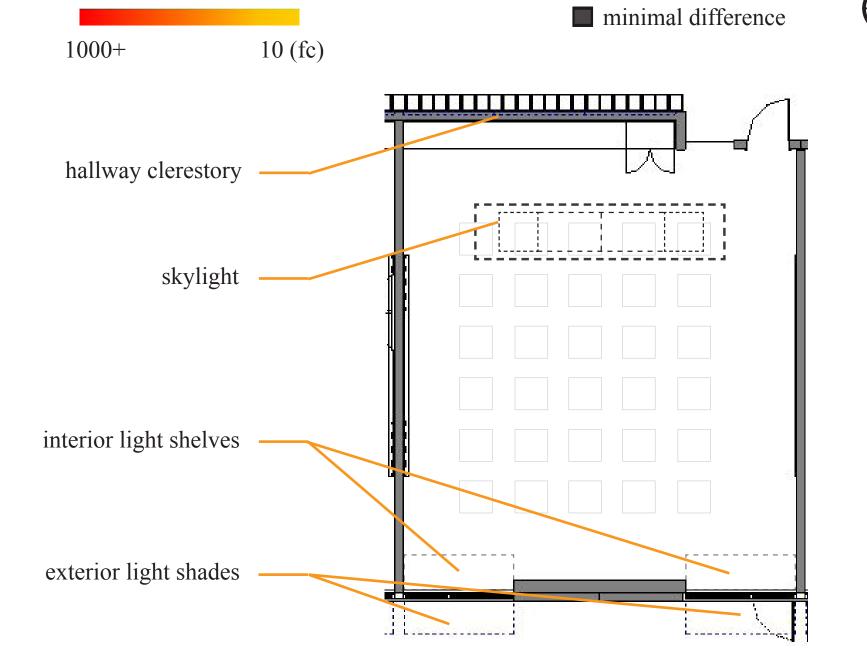
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P	53%	9%	35%	26%	25%	58%	77%
	44%	43%	43%	62%	55%	72%	84%
	36%	40%	54%	66%	47%	65%	82%
	30%	93%	95%	60%	54%	57%	97%
	37%	29%	52%	59%	41%	56%	83%
4	26%	12%	35%	65%	50%	88%	47%

47% 70% 53%

PERCENT DIFFERENCE

						 	Λ
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	61%	47%	44%	20%	31%	16%	-21%
	52%	42%	39%	36%	47%	35%	39%
	35%	22%	41%	52%	40%	39%	36%
	45%	46%	57%	92%	60%	56%	27%
	56%	47%	29%	54%	46%	49%	60%
	35%	4%	94%	65%	48%	2%	82%
	36%	84%	53%	71%	51%	84%	31%
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nuary 26, 2014 lear Sky Model