Fall 2015

Baseline Daylight Autonomy and Glare

Portland State University. School of Architecture

USEFUL DAYLIGHT ILLUMINANCE

EXISTING BASELINE

	9:00 AM	12:00 PM	3:00 PM
OCT 21st	HIGH-BAY: 399 SAWTOOTH: 67	HIGH-BAY: 579 SAWTOOTH: 96	HIGH-BAY: 368 SAWTOOTH: 61
JAN 21st	HIGH-BAY: 243 SAWTOOTH: 40	HIGH-BAY: 469 SAWTOOTH: 76	HIGH-BAY: 468 SAWTOOTH: 80
APR 21st	HIGH-BAY: 789 SAWTOOTH: 132	HIGH-BAY: 786 SAWTOOTH: 131	HIGH-BAY: 604 SAWTOOTH: 101

MEAN ILLUMINANCE GIVEN BY SPACE (LUX)

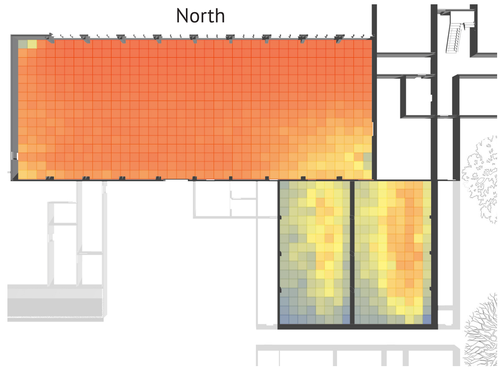
KEY

200
500
800
1100
1400
1700
2000
< 200
> 2000

OPTION B ANALYSIS

	9:00 AM	12:00 PM	3:00 PM
OCT 21st	HIGH-BAY: 513 SAWTOOTH: 133 VESTIBULE: 1693 LECTURE: 136	HIGH-BAY: 542 SAWTOOTH: 142 VESTIBULE: 1797 LECTURE: 140	HIGH-BAY: 327 SAWTOOTH: 85 VESTIBULE: 1078 LECTURE: 86
JAN 21st	HIGH-BAY: 216 SAWTOOTH: 57 VESTIBULE: 712 LECTURE: 58	HIGH-BAY: 418 SAWTOOTH: 108 VESTIBULE: 1374 LECTURE: 111	HIGH-BAY: 284 SAWTOOTH: 75 VESTIBULE: 933 LECTURE: 75
APR 21st	HIGH-BAY: 514 SAWTOOTH: 135 VESTIBULE: 1696 LECTURE: 138	HIGH-BAY: 699 SAWTOOTH: 185 VESTIBULE: 2304 LECTURE: 186	HIGH-BAY: 537 SAWTOOTH: 142 VESTIBULE: 1771 LECTURE: 145

BASELINE DAYLIGHT AUTONOMY AND GLARE



FINDINGS

ILLUMINANCE:

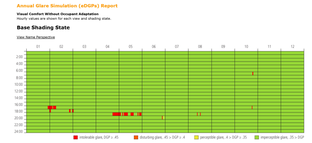
We found that the Large High-Bay space benefits from a balance of North and Sout glazing which limits high-glare conditions. Some areas could benefit from added fenestration while others will clearly require shading devices to maximize user comfort, key to keeping lighting loads to a minimum post-occupancy.

DAYLIGHT AUTONOMY:

The autonomy findings show that, with appropriate spatial planning, daylight could provide a significant portion of interior light based on program needs.

GLARE:

Our glare findings were confusing at first, but the reality is that this space has an existing design which limits glare conditions. Additional acccuracy would result from a model populated with work surfaces and materials not considered in the scope of this investigation.



PORTLAND STATE UNIVERSITY - PROFESSOR COREY GRIFFIN

OVERVIEW

With the 2050 Energy Challenge in mind, many institutions are embracing strict policies on energy consumption in order to be at the vangaurd of sustainable practice. The California State Educational System is one such organization, specifying a 25% below code requirements for University buildings. This project specifically involves a retrofit of Cruess Hall, a former shop and storage space on the campus of UC Davis.

Our first task was establishing a baseline from which we can understand the conditions of existing light quality. The project is in design development stage, so after a baseline is established design suggestions can be made to improve daylighting based on DIVA analysis. One such design option is presented here in contrast to the existing condition both as an informant of design but also of new methods for achieving greater efficiency and user comfort.

METRICS

Daylight Autonomy: a percentage of annual daytime hours that a given point in a space is above a specified illumination level (300 lux) while occupied.

Illuminance: the amount of light energy reaching a given point on a defined surface area, usefull measures of illuminace are determined by ASHRAE standards according to specific tasks that will be done in a given space. (measured in Footcandles and Lux)

Glare: Physical discomfort caused by contrast in light conditions or luminous intensity. Glare is measured from specific points of view as a ratio of light levels in a given cone of vision. Glare can be difficult to model accurately, but is important in understanding comfort and useability of interior spaces

Lux: Unit of measurement of incident light equivalent to .1 footcandle

OBJECTIVES

PRIMARY:

-Establish existing condition Daylight Autonomy during occupied hours.

-Develop a results matrix showing moment-in-time illuminance and glare for ex. and new.

-Use data to inform artificial lighting strategies with new fenestration and shading devices.

-Achieve UC Davis' stringent energy requirements in modeling.

SECONDARY:

-Combine Daylighting and Thermal Envelope findings to produce a cumulative DIVA analysis.

-Produce an updated 'best-case' workflow for DIVA daylight analyses.

-Develop appendix of relevant terminology

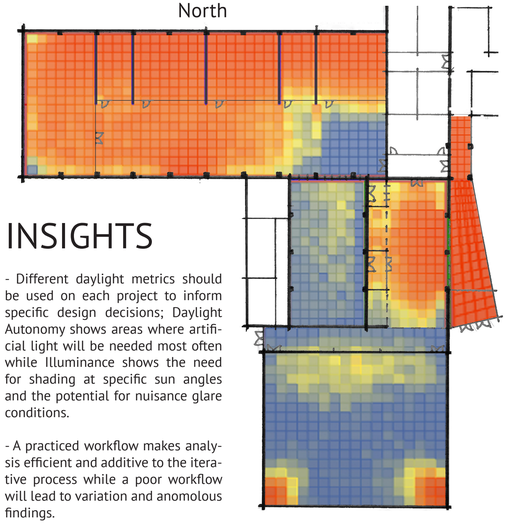
HACKER

ARCHITECTS

UC DAVIS - CRUESS HALL RENOVATION

DIVA DAYLIGHT ANALYSIS

JESSE FIGGINS CIAN BOUMA TUCKER JONES ZACH BAUGHER



INSIGHTS

- Different daylight metrics should be used on each project to inform specific design decisions; Daylight Autonomy shows areas where artificial light will be needed most often while Illuminance shows the need for shading at specific sun angles and the potential for nuisance glare conditions.

- A practiced workflow makes analysis efficient and additive to the iterative process while a poor workflow will lead to variation and anomolous findings.

FINDINGS

ILLUMINANCE:

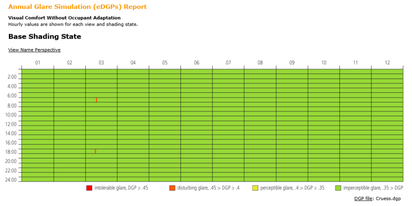
Illuminance conditions were improved through the addition of North-South partitions in the High-Bay space while the new lobby is flooded with natural light via the doorway which would pierce its East facade. An added curtain wall vestibule may complicate thermal loading but would require very little artificial lighting.

DAYLIGHT AUTONOMY:

Autonomy in Option B appears to embrace the proposed program of these spaces. The Sawtooth portion, now divided into a small lecture hall (West) and lobby (East) shows a desired daylight response to the changes. The new South lecture hall should be studied further but any desired lighting condition can be achieved on this new construction.

GLARE:

Any initial glare concerns were further winnowed through the division of the High-Bay space into North-South programmed rooms which are flooded by daylight. Circulation spaces show varying light intensity and are the areas of greatest potential glare under this iteration. Finding the right glare metric may provide greater insight as to actual user experience of these spaces once further-modeled.



OPTION B DAYLIGHT AUTONOMY AND GLARE