CASE STUDY #1
"A DAYLIGHTED ROOM"

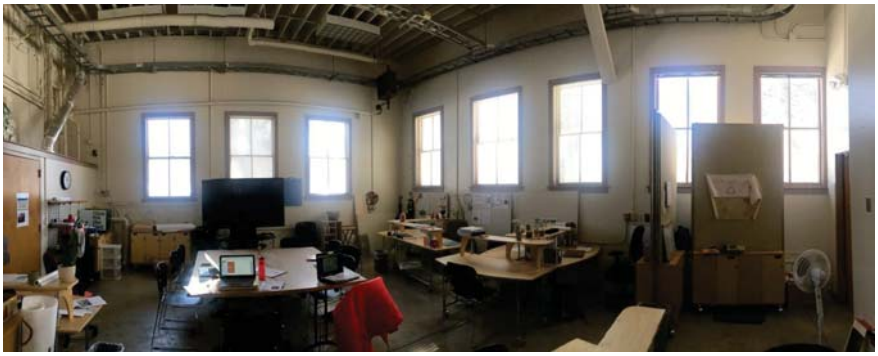
By Kelli Fry, Erin Salskov, Jordyn McKnight

BUILDING DESCRIPTION:
ART & ARCHITECTURE
INTERIOR DESIGN
STUDIO ROOM 100

The interior design studio is located on the 1st floor of the Art and Architecture building. The space is used for senior interior design students as a classroom with workspaces throughout, which are located on the perimeter of the room.

The building itself was constructed in 1906 out of a wood frame with red pressed brick veneer walls, includes three stories, and a gable roof with cedar shingles.

BUILDING ANALYSIS:
CURRENT DAYLIGHTING PERFORMANCE



Currently, the windows occupy the south and west facades of the building. Each window is
3 x 7, with 3 of them on the south wall and 5 of them on the west wall. All windows include manual blinds for shading, since most of the sunlight shines through from the south.

The glazing system consists of all glass sash windows, though some windows do not properly open all of the way.

The room has an adequate amount of daylight pouring in, with the potential to be improved upon even more.

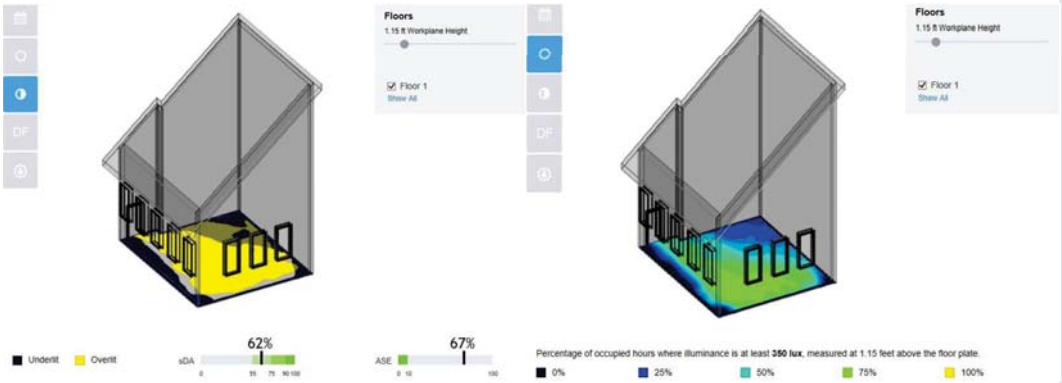
EXISTING PERFORMANCE ANALYSIS:
ILLUMINANCE DAYLIGHT FACTORS

Illuminance footprint in LUX

aa 100: illuminance footprint | 1:00 p.m. | daylight only

EXISTING PERFORMANCE ANALYSIS USING SEFAIRA

ANNUAL LIGHTING



The studio space is mostly overlit, with an sDA of 62%, and as ASE of 67%. The center of the room is the most well-lit area overall, with the perimeter of the space being darker than the rest annually.

LIGHTING ZONES & PERFORMANCE

ELECTRICAL LIGHT:

Troffer 2 X 4 ceiling light 178 Watts per fixture

Troffer light

Daylight

EXISTING PERFORMANCE ANALYSIS:
Illuminance daylight factor

Illuminance footprint in LUX

aa 100: illuminance footprint | 6:00 p.m. | electric light only

ENERGY USAGE OF ELECTRICAL LIGHTING

2'x4' troffer 178W : (12 total) (4 4' lamps in each troffer)
mode 1: 1,068 watts mode 2: 2,136 watts
operable: mode 1 - turns 6 troffers on, mode 2 - turns 12 troffers on

Sufficient Daylighting:
-clear Skies (Sunny): 7:00 a.m. - 9:00 p.m (14 hours)
-cloudy Skies: 8:30 a.m. - 3:30 p.m. (7 hours)

Mechanical Light Needed: (14 total building hours)
-clear skies (sunny): 2hours x (2,136 watts) = 4,272 watts
-cloudy skies: 7 hours x (2,136 watts) = 14,952 watts

Lamps OFF:
-clear skies (sunny) - save 4,272 watts
-cloudy skies - save 14,952 watts

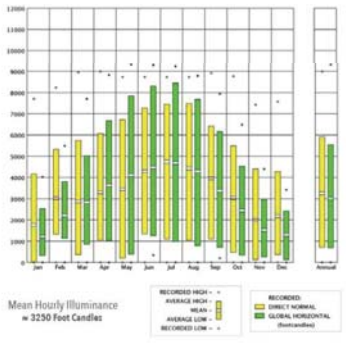
Yearly Savings:
-95 Days (clear skies) - 95 x (4,272 watts) = 405,840 watts yearly
-169 Days (cloudy) - 169 x (14,952 watts) = 2,525,888 watts yearly

MOSCOW IDAHO CLIMATE

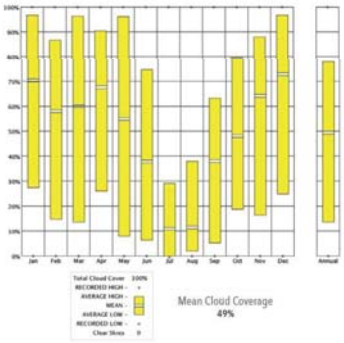
MOSTLY OVERCAST DAYS

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Clear Days	8	8	7	7	7	7	10	10	10	10	5	6	95
PT Cloudy Days	7	7	7	8	9	10	12	11	8	7	6	6	98
Overcast Days	15	14	17	15	15	12	9	10	12	14	18	18	169
% Clear	27	28	23	23	23	24	32	32	33	32	17	20	26.16
% PT Cloudy	23	24	23	27	29	34	39	35	27	23	21	20	27.08
% Overcast	50	48	55	50	48	41	29	32	40	45	62	60	46.66

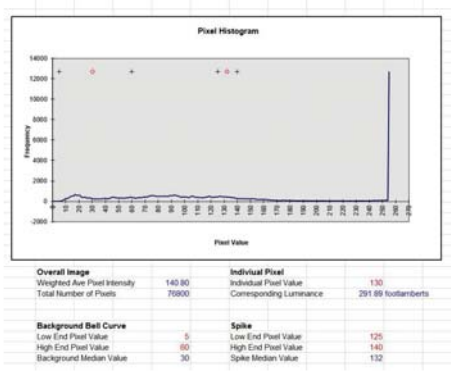
HOURLY ILLUMINANCE



MEAN CLOUD AVERAGE 49%



EXISTING GLARE ANALYSIS



EXISTING GLARE ANALYSIS:

Daylight is extremely intense since there aren't any means of diffusing it, other than manually closing the blinds.

Southern/eastern interior space receives the most direct sunlight.

Workspaces along the east wall receive the most unwanted glare due to reflective surfaces and direct sunlight.

REDESIGN PROPOSAL

-Adding top lighting (skylights), will aid in lighting the northeast corner of the space which normally relies on mechanical lighting 75% of the hours of operation.

-Adding rectangular clerestory windows on the South facade, with the addition of exterior shading devices, will help bring daylight into the space, specifically into the northeast corner, and provide a more even wash of light throughout the day.

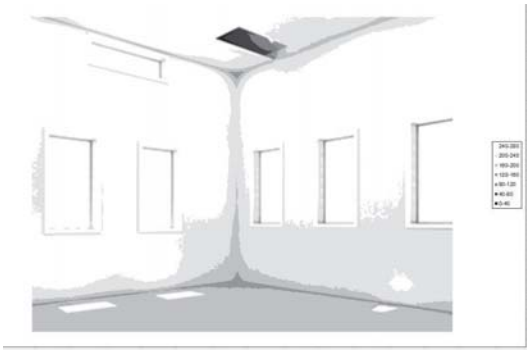
-Wall finishes could be changed to a semi-gloss or eggshell white to further reduce glare within the space.

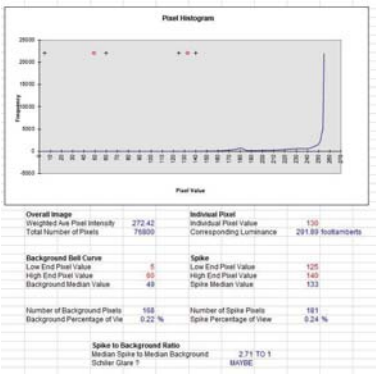
-The addition of exterior shading louvers, in addition to mechanical blinds, will help decrease the amount of glare in the space while allowing a maximum amount of light into the room.

REDESIGN USING SEFAIRA

With the addition of a few skylights, as well as 2 clerestory windows, our space is mostly overlit. With that, our sDA is 72% and our ASE is 73% which is an improvement overall. Annually, the majority of the space is well-lit, even the perimeter of the room with the new redesign.

REDESIGN GLARE ANALYSIS





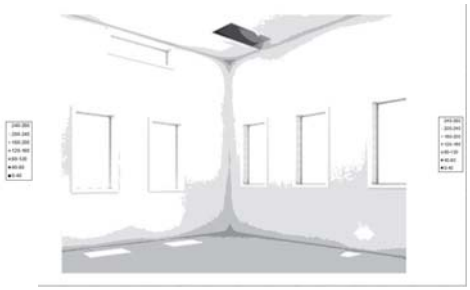
REDESIGN GLARE ANALYSIS:

Daylighting is significantly improved within the space, allowing for a maximum amount of daylight to enter the space, especially in the north east corner.

Southern/eastern interior space receives
the most direct sunlight, and with the addition of exterior shading louvers, the space will be able to control the amount of light penetration within the space at any given time in the day.

Workspaces along the east wall receive the maximum amount of light, however; the addition of the skylights and clerestory windows will allow a more even wash of light throughout the space and improve the overall quality and evenness of life within the room.

REDESIGN BEFORE AND AFTER



Redesign before and after with the addition of 3 skylights on the west side, and 2 clerestory windows on the south side.

CONCLUSION

			Base	Case 1	Case 2
1.	Enter LATitude of building location	LAT =	46.7	46.7	46.7
2.	Enter the Daily Occupancy Period Code from box below (1-11):	DOPC =	7	7	7
	1=7a3p, 2=7a4p, 3=8a4p, 4=8a5p, 5=8a6p, 6=8a7p, 7=8a8p, 8=9a5p, 9=9a6p, 10=9a7p, 10=9a8p, 11=9a9p				
3.	Enter Typical Floor Width (ft):	FL =	26	26	26
	Enter Typical Floor Length (ft):	FW =	29	29	29
	Typical Floor Area (f) = FL * FW =	FA =	754	754	754
4.	Typical Floor Shape (Length ÷ Width) =	FS =	1.11538461	1.11538461	1.1153846
5a.	Enter Lighting Control Type (1 = on/off; 2 = dimming):	LCT =	1	1	1
5b.	Enter Design Illuminance Level (30, 50, or 70 fc) =	DIL =	50	30	30
5c.	Enter window area per floor above the workplane (sf)	WAAW =	650	650	650
	Enter typical ceiling height above floor (ft)	CH =	20	8.5	8.5
	Floor Perimeter (ft),	FP =	110	110	110
	Side-Lighting Glass Area Fraction = WAAW ÷ (CH * FP) =	SLGAF =	0.295	0.695	0.695
	Enter skylight or monitor glazed area (sf):		0	0	0
	Top-Lighting Glass Area Fraction: glazed aperture area ÷ floor area =	TLGAF =	0	0	0
5d.	Enter Side-Lighting Glass Visible Transmittance (0-0.8)	= SLGVT =	0.8	0.8	0.8
	Enter Top-Lighting Glass Visible Transmittance (0-0.8)	= TLGVT =	0	0	0
	Enter Well Factor (0.2 to 1.0; depends on well depth and reflectance)	WF =			
6.	Enter Annual Hours of Occupancy (hr)	AHO =	4,000	2500	2500
7.	Enter Installed Lighting Load (watts/sf; typically 1.0 to 3.0)	ILL =	2.5	2.5	2.5
8.	Electricity Cost ($/kWh; typically 0.10 to 0.25)	EC =	$0.15	$0.10	$0.10
9.	Enter No. of Floors:	NF =	1	5	5
	Enter daylighted width (ft; 15 is typ. for conventional windows)	DW =	15	15	15
	Gross Total Building Area = NF * GAPF =	GTBA =	754	3770	3770
10.	Enter Non-Lighting Electric Load (watts/sf; 3.0 is typical for office buildings)		0.0	3.0	3.0
11.	Peak Electric Utility Demand Rate ($/kW-month; 2.50 is typical for office bldgs):	PDR =	$1.70	$1.70	$1.70
12.	Daylighted Hours (determined from DOS)		83.0%	83.0%	83.0%
13.	Total Daylighted Area (% of total; based on entered depth for sidelit; 100% for top):	TDA =	99%	99%	99%
14.	Control Effectiveness (determined by LCT, side or top-lighting, and DIL):		64%	64%	64%
15.	Enter Dimming Factor (0 - 1.0; typically 0.8 for dimming systems, 1.0 for on/off)	DF =	0.85	0.85	0.85
16.	Annual Energy Savings Due to Daylighting		50.8%	50.8%	52.8%

By adding top lighting to the space, the north east corner will have better illumination for most of the hours of the day.

Working with the existing glazing and adding the addition of exterior louvers will help reduce glare within the building.

By adding clerestory windows along the south facade will help bring in a more even wash of light, and help light penetrate the space further. The addition of exterior shading louvers will aid in controlling glare and solar gain.

Mechanical blinds will remain in the space and allow users to manually control how much light is needed for activities within the space.

Annual Energy Savings Due to Daylighting:

51.2 - 52.8%