

Daylight Analysis Interior Desing Studio



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UNIVERSITY OF IDAHO COLLEGE OF ART AND ARCHITECTURE 4TH YEAR INTERIOR DESIGN STUDIO



OBJECTIVE:

To access the existing daylight conditions of the space and propose a redesign idea to improve the day lighting in the space

OVERVIEW:

The studio is located on the first floor in one of the older buildings on campus
Approximately 1089sf studio space
1716sf total

Its primary use is for design students as well as two faculty offices
The space uses the combination of a fair amount of existing daylight coming in from its southern and western facing walls as well as electrical lighting



MOSCOW IDAHO'S CLIMATE AND LIGHTING CONDITIONS

Cloud cover in Moscow Idaho is approximately 169 days a year, 46% of the year (diagram c)

HOURL	J	F	M	A	M	J	J	A	S	O	N	D	
CLR DAYS 0:0-2:0	8	8	7	7	7	7	10	10	10	10	5	6	95
PT CD DAYS 3:0-6:0	7	7	7	8	9	10	12	11	8	7	6	6	101
DIV DAYS 7:0-9:0	15	14	17	12	18	17	9	10	10	14	10	10	169
% CLR	27	28	23	23	24	32	32	33	32	17	20	26%	
% PT CD	23	24	23	27	29	34	39	35	27	23	21	20	28%
% DIV	50	49	50	50	48	41	29	32	40	45	52	50	46%

Sky Cover Monthly Normals (Diagram C)
Eighths of Sky covered, % days for each sky condition.

Average luminance during June ranges between 10-40 klux-hr (cloudy) to 11-51 (clear)

		June				December			
		8 am	11 am	1 pm	3 pm	8 am	11 am	1 pm	3 pm
MOSCOW	M. Clear	40	39	37	34	7	3	3	2
	M. Cloudy	22	24	27	28	4	5	5	5
MOSCOW	M. Clear	15	15	15	17	15	3	8	7
	M. Cloudy	13	17	18	18	16	7	8	8
MOSCOW	M. Clear	19	14	16	17	12	20	17	9
	M. Cloudy	25	42	39	18	16	7	12	8
	% Clear	71	38	34	27	25	75	59	34
	% Cloudy	29	62	66	73	75	25	41	66
	M. Clear (% hrs)	38	34	33	31	34	24	27	27
	M. Cloudy (% hrs)	38	34	33	31	34	24	27	27

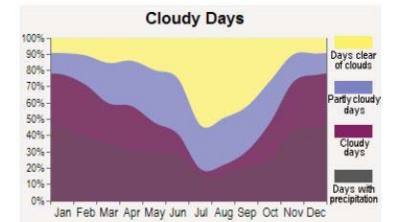
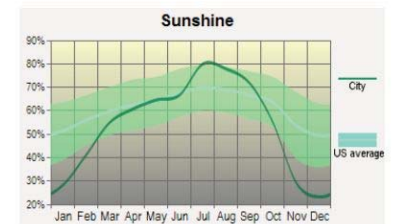
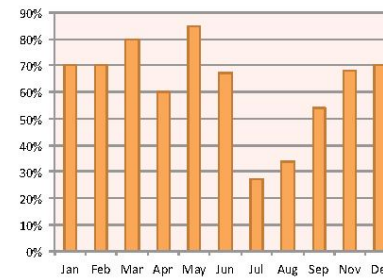
Average Incident Illuminance (klux-hr) (Diagram D)

10 DAYLIGHT OBSTRUCTIONS
Overcast Dot Charts are in Technique 10. For Clear Sky Dot Charts, see Appendix B.

AVAILABLE DAYLIGHTING

Moscow's clearest skies are between June and September

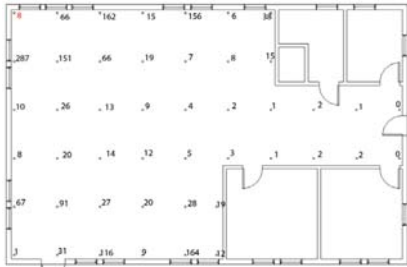
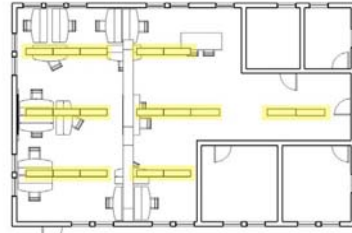
Annual cloud coverage chart



EXISTING LIGHTING

Existing Electrical Scheme:
 Fluorescents- 18 fixtures (X) 2 lamps =
 32 lamps
 Sylvania Octron XP Lamps @ 32 watts

Daylighting Scheme:
 Average Lux. Int. = 37.43 Ext. = 555 Daylight factor = 6.74%



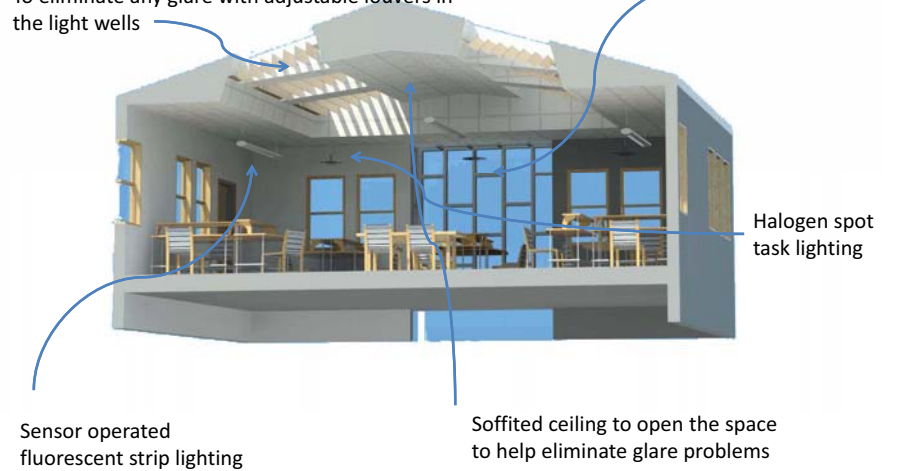
Analysis taken @ 4:00pm February 6th



REDESIGN PROPOSAL

Add 205sf of skylight to increase the amount of morning to noon light into the studio space and To eliminate any glare with adjustable louvers in the light wells

Replace existing fireplace & chimney with a 10' wide floor to ceiling light aperture to allow for greater mid day and afternoon light into the space



DAYLIGHTING COMPARISON

(Analysis uses same exposure settings)

Current daylighting for February 6th, 10:00am

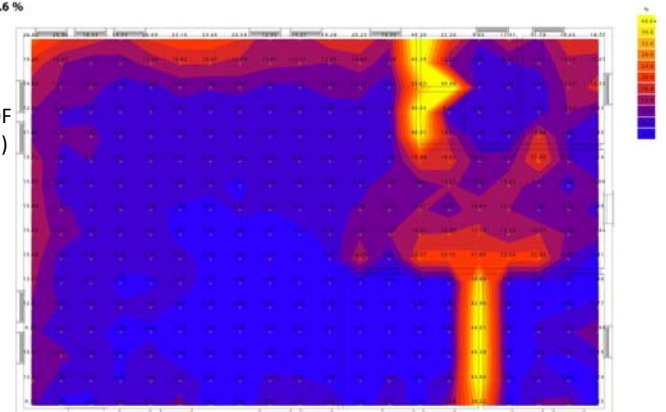


Purposed redesign (w/o redesigned western daylight aperture) louvers fully open

PERFORMANCE ANALYSIS

Daylight Analysis
 Daylight Factor
 Contour Range: 0.6 - 40.6 %
 In Steps of: 4.0%
 © ECOTECT v5

Before:
 Average value 9.57% DF
 (February 6th 10:00am)

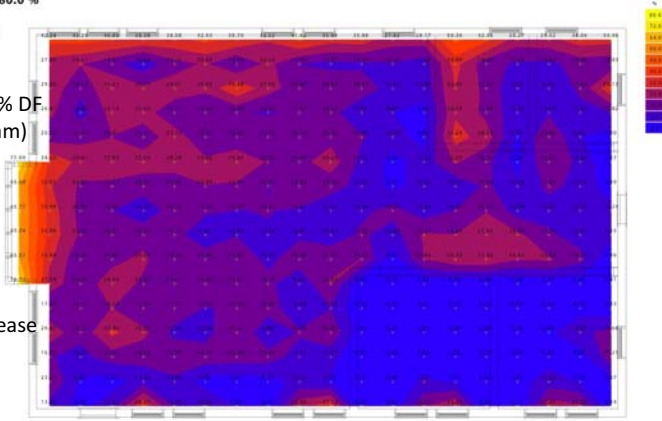


Average Value: 9.57 %

PERFORMANCE ANALYSIS

Daylight Analysis
Daylight Factor
Contour Range: 0.0 - 80.0 %
In 5 steps of: 8.0 %
© ECOTECT v5

After:
Average value 18.44% DF
(February 6TH 10:00am)



Average Value: 18.44 %

*8.87% overall increase

ENERGY SAVINGS

Current daylighting performance:
61.2% peak load savings due to daylighting

Redesigned daylighting performance:
66.7% peak load savings due to daylighting

= 5.5% savings increase from new daylight apitures

ENERGY SAVINGS DUE TO DAYLIGHTING			
Based on Sakamoto, S., and Gabriel, M. 1994. "DL Daylighting Homographs." LBN Report 1204, Berkeley, CA: Lawrence Berkeley Laboratory.			
Spreadsheet by Folar Moore, Architecture Department, Miami University, Oxford OH 45056 (e-mail: fmoore@aol.com)			
	Base	Case 1	Case 2
1. Enter LA/Trade of building location	LA1 =	48.75	48.75
2. Enter Day Occupancy Period Code from box below (1-11): 1=7-9p, 2=7-9a, 3=8-9p, 4=8-9a, 5=8-9p, 6=8-9a, 7=9-5p, 8=5-9p, 9=5-9a, 10=9-5p, 11=day	DOCP =	1	1
3. Enter Typical Floor Width (ft)	FW =	31.3	31.3
4. Enter Typical Floor Length (ft)	FL =	31.3	31.3
5. Enter Typical Floor Area (ft²)	FA =	1099.69	1099.69
6. Enter Typical Floor Shape (Length x Width = FA)	FSH =	1.000015	1.000015
7. Enter Lighting Control Type (1 = on/off, 2 = dimming)	LCT =	1	2
8. Enter Design Illuminance Level (50, 80, or 100 fc)	DEL =	50	75
9. Enter window area per floor above the workspace (ft²)	WAMR =	193	293
10. Enter typical ceiling height above floor (ft)	CH =	10	10
11. Enter skylight or monitor glazed area (ft²)	SMGA =	0	200
12. Enter Side Lighting Glass Area Fraction = WAMR / (CH * FA) = SLGAF	SLGAF =	0.146	0.222
13. Enter Side Lighting Glass Visible Transmittance (0-0.8)	SLGVT =	0	0.8
14. Enter Side Lighting Glass Visible Transmittance (0-0.8) = SLGVT	SLGVT =	0	0.8
15. Enter Well Factor (0.2 to 1.0, depends on well depth and reflectance)	WF =	0	1.0
16. Enter Annual Hours of Occupancy (hr)	AHO =	2000	2000
17. Enter Installed Lighting Load (watts/ft², typically 1.0 to 3.0)	ILL =	2.5	2.5
18. Electricity Cost (\$/kWh, typically 0.10 to 0.25)	EC =	0.10	0.10
19. Enter No. of Hours	NH =	1	1
20. Enter daylighted width (ft), 15 is typ. for conventional windows	DW =	15	15
21. Enter Non Lighting Electric Load (watts/ft², 3.0 is typical for office buildings)	NLEL =	100.00	100.00
22. Peak Electric Utility Demand Rate (\$/kW-month, 2.50 is typical for office buildings)	PEUR =	0.10	0.10
23. Daylighted Hours (determined from DOCP)	DH =	98.2%	98.2%
24. Total Daylighted Area (ft²) or rate based on assumed depth for worst, 100% for best	TDA =	99%	100%
25. Control Effectiveness (assumed by CCT, side or top lighting, and DEL)	CE =	54%	49%
26. Enter Dimming Factor (0 - 1.0, typically 0.8 for dimming systems, 1.0 for on/off)	DF =	0.80	0.80
27. Peak Load Savings Due to Daylighting	PLSD =	61.2%	66.7%
28. Non-Daylighted Lighting Energy Consumption (MWh/yr)	NLDLEC =	6.60	6.60
29. Non-Daylighted Lighting Consumption Cost (\$/yr)	NLDLCC =	\$0.50	\$0.50
30. Daylighting Energy Savings (\$/hr-yr)	DES =	\$3.83	\$4.17
31. Daylighting Consumption Savings (\$/hr-yr)	DCS =	\$0.38	\$0.42
32. Annual Energy Consumption Cost Savings Due to Daylighting for Building (\$1000)	AECS =	\$0.4	\$0.3
33. Non-Daylighted Peak Demand (kW)	NLDPD =	3.267075	5.9896375
34. Non-Daylighted Monthly Demand Charge (\$/kW-month)	NLDMD =	0.0000	0.0043
35. Non-Daylighted Annual Demand Charge (\$/kW-yr)	NLDADC =	\$0.00	\$0.051
36. Daylighted Peak Demand Savings (kW)	DPDS =	0.0	2.7
37. Daylighted Annual Demand Savings (\$/kW-yr)	ADDS =	0.0000	0.0043
38. Daylighted Monthly Demand Savings (\$/kW-month)	MDDS =	0	0.000476
39. Building Annual Savings Due to Daylighting Consumption and Demand, per yr	BASS =	472	501
40. Enter Extra Construction Cost Due to Daylighting (\$/ft²)	ECOC =	100.00	100.00
41. Simple Payback Period (Extra Const Cost - Bldg Annual Savings)	SPAP =	211.9555	199.595
42. Simple Return on Daylighting Investment (Bldg Annual Savings + Extra Const Cost)	SR =	0%	1%

REDESIGN APITURE CONFIGURATIONS



NORTH LOUVERS CLOSED



NORTH LOUVERS OPENED



CONCLUSION

With the addition of over 300sf of new daylight apertures we do not see a very large overall energy savings but the daylight factor doubles with this new design along with a 5.5% increase in energy savings.

Adding skylights to the space will increase the depth of light throughout the space and makes the room feel and look bigger.

Skylight louvers will allow the occupant to have control over the amount of daylighting entering the room thus allowing a better control of the environment.

