Case Study 1

Nicole Collie & Elna Albano

The Storm Cellar

Question A

Lighting Sweep

-Solid cloud cover on day of site visit

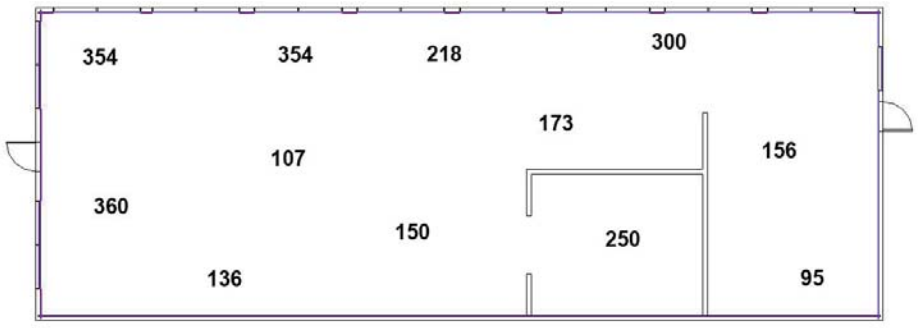
-250L w/ electric lighting in dressing rooms

-354L in very bright windowed areas

-95L in back windowless corner of storage

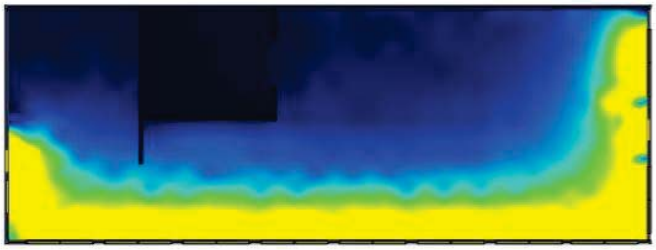
-North and west facing walls all windows

-South wall adjoins another building



Question A

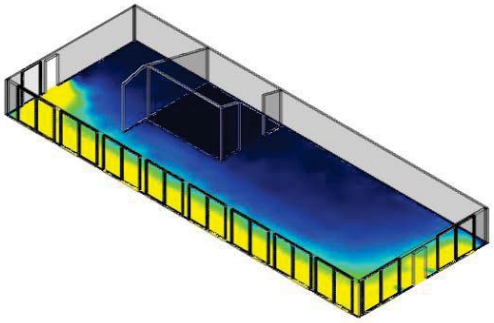
Existing Daylighting System

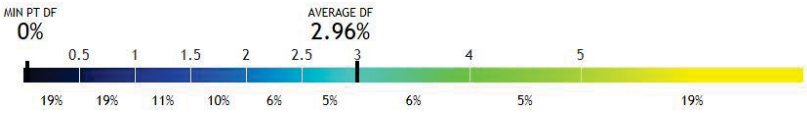


-A little over half the space is very well lit by existing windows

-The enclosed dressing room is very poorly daylit

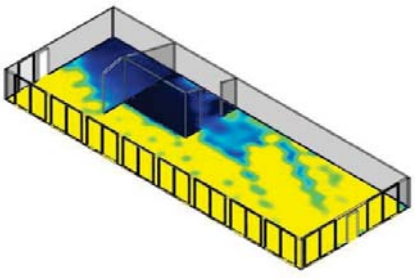
-The back wall contains no windows as it is shared with another building





Question A

June 21



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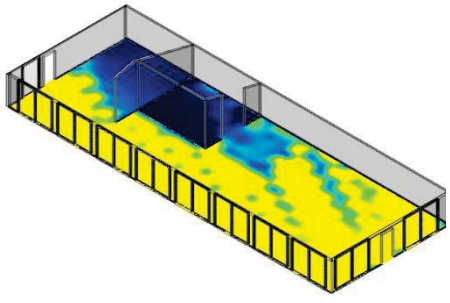

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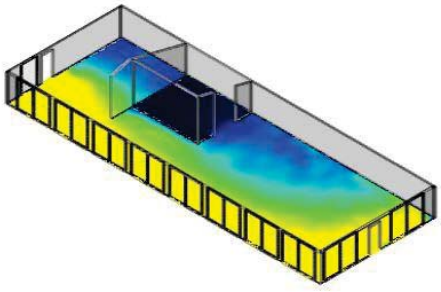
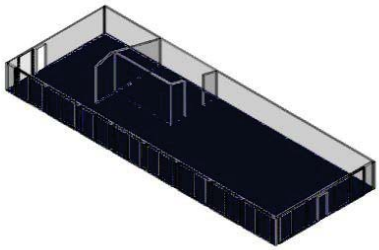


6 pm

As seen in diagrams, north-facing windows receive ample sunlight throughout the entire summer day.

Question A

September 21



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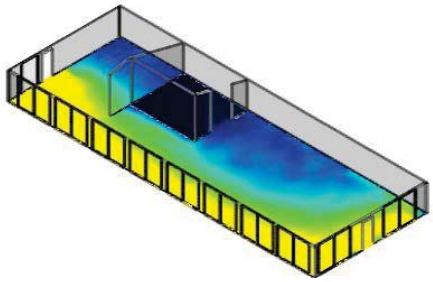

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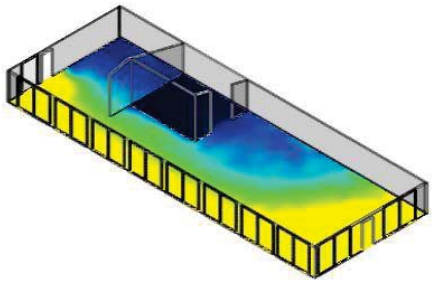


6 pm

During the fall season, the space receives no daylight in the morning but plenty of light during daylight hours.

Question A

Direct Sunlight

-Summer: no direct sunlight enters

-Keeps space cool during hot months

-Winter: some sunlight enters

-Allows small amount of warmth during cool months

Summer

Winter

Question A

Glare Analysis

-The semi-glossy concrete floor creates some glare, but not problematic

Question B

Light Fixture Analysis

Incandescent Bulbs: $0.03 daily, $10.95 per year, 40W . 180 bulbs x $10.95 = **$1,971 per year**. 180 bulbs x 40W = **7200 watts per hour**

Fluorescent Lighting: $0.49 daily, $17.64 per year, 17W. 40 tubes x $17.64 = **$705.60 per year**. 40 tubes x 17W = **680 watts per hour**

Total for Building: $1,971 + $705.60 = **$2,676 annually**

680W + 7,200W = **7,800W annually**

7.880 KW x 9 hrs/day x 260/year = **18,439.2 kW/year**

Savings Due to Adequate Daylighting: 7.880kW x 4.5 hrs/day x 260 days/year = 9,219.6 kW/year

Half the energy is saved through the use of good daylighting!

Question B

LBL Nomograph

-Base: The Storm Cellar as it exists now, but without any daylight

-Case 1: The Storm Cellar as it exists now with daylight and electric lighting

-Case 2: The Storm Cellar with our proposed improvements

The way it is designed now already saves 47% of energy costs annually because of daylighting. With our proposed redesign, that number jumps to 63.4%*.

*See Line 16

			Base	Case 1	Case 2
1.	Enter LATitude of building location	LAT =	46.75	46.75	46.75
2.	Enter the Daily Occupancy Period Code from box below (1-11):	DOPC =	4	5	5
	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 =	42	42	42
	Enter Typical Floor Length (ft):	FW =	115	115	115
	Typical Floor Area (f) = FL * FW =	FA =	4830	4830	4830
4.	Typical Floor Shape (Length ÷ Width) =	FS =	2.7381	2.7381	2.7381
5a.	Enter Lighting Control Type (1 = on/off; 2 = dimming):	LCT =	0	1	2
5b.	Enter Design Illuminance Level (30, 50, or 70 fc) =	DIL =	0	50	70
5c.	Enter window area per floor above the workplane (sf)	WAAW =	0	550	550
	Enter typical ceiling height above floor (ft)	CH =	10	10	10
	Floor Perimeter (ft),	FP =	314	314	314
	Side-Lighting Glass Area Fraction = WAAW ÷ (CH * FP) =	SLGAF =	0.000	0.175	0.175
	Enter skylight or monitor glazed area (sf):		0	0	30
pp-	Lighting Glass Area Fraction: glazed aperture area ÷ floor area =	TLGAF =	0	0	0.0062
5d.	Enter Side-Lighting Glass Visible Transmittance (0-0.8)	= SLGVT =	0	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 reflectanc	WF =			
6.	Enter Annual Hours of Occupancy (hr)	AHO =	2800	2800	2800
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 =	$0.10	$0.10	$0.10
9.	Enter No. of Floors:	NF =	1	1	1
	Enter daylighted width (ft; 15 is typ. for conventional windows)	DW =	0	15	15
	Gross Total Building Area = NF * GAPF =	GTBA =	4830	4830	4830
10.	Enter Non-Lighting Electric Load (watts/sf; 3.0 is typical for office building		3.0	3.0	3.0
11.	Peak Electric Utility Demand Rate ($/kW-month; 2.50 is typical for PDR =		$1.70	$1.70	$1.70
12.	Daylighted Hours (determined from DOS)		96.5%	93.0%	93.0%
13.	Total Daylighted Area (% of total; based on entered depth for sidelit; 100% for t	TDA =	0%	79%	100%
14.	Control Effectiveness (determined by LCT, side or top-lighting, and DIL):		#DIV/0!	64%	68%
15.	Enter Dimming Factor (0 - 1.0; typically 0.8 for dimming systems, 1.	DF =	0.85	0.85	0.85
16.	Annual Energy Savings Due to Daylighting		#DIV/0!	47.0%	63.4%
17.	Peak Load Savings Due to Daylighting		0.0%	67.0%	85.0%
18.	Non-Daylighted Lighting Energy Consumption (kWh/sf-yr)		7.00	7.00	7.00
19.	Non-Daylighted Lighting Consumption Cost ($/sf-yr)		$0.70	$0.70	$0.70
20.	Daylighting Energy Savings (kWh/sf-yr)		#DIV/0!	$2.93	$3.96
21.	Daylighting Consumption Savings ($/sf-yr)		#DIV/0!	$0.29	$0.40
22.	Annual Electric Consumption Cost Savings Due to Daylighting for Buildi		#DIV/0!	$1.4	$1.9
23.	Non-Daylighted Peak Demand (kW)		26.565	26.565	26.565
24.	Non-Daylighted Monthly Demand Charge ($/kW-month)		0.0043	0.0043	0.0043
25.	Non-Daylighted Annual Demand Charge ($/kW-yr)		$0.051	$0.051	$0.051
26.	Daylighted Peak Demand Savings (kW)		0.0	8.1	10.3
27.	Daylighted Annual Demand Savings ($/sf-yr)		0.0000	0.0028	0.0036
28.	Daylighted Monthly Demand Savings ($/sf-month)		0	0.0342	0.0434
29.	Total Annual Savings Due to Daylightng (Consumption and Demand $/sf		#DIV/0!	$0.328	$0.440
30.	Building Annual Savings Due to Daylightng (Consumption and Demand		#DIV/0!	1,582	2,123
31.	Enter Extra Construction Cost Due To Daylighting ($/bldg)	DC =	100000	100000	100000

Question C

Climate and Site Analysis

-Winter in Moscow is primarily cloudy

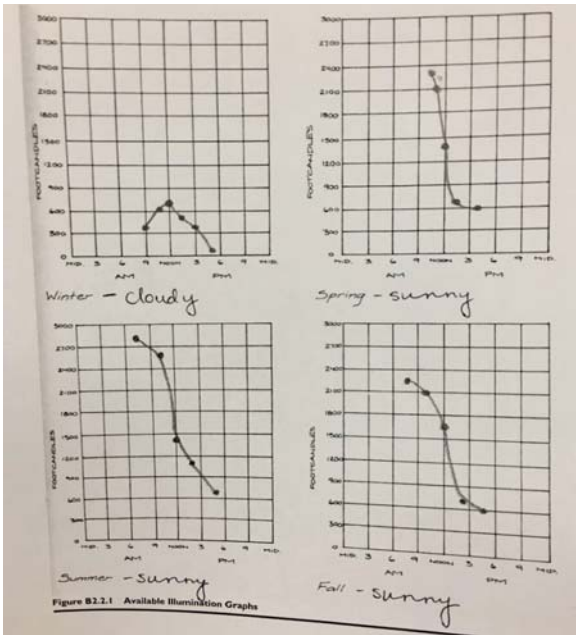
-Spring in Moscow is primarily sunny

-Summer is Moscow is primarily sunny

-Fall in Moscow is primarily sunny

-Each season is graphed using average data for each

-Summer is the most lit season with highest lumens at 2520



Question C

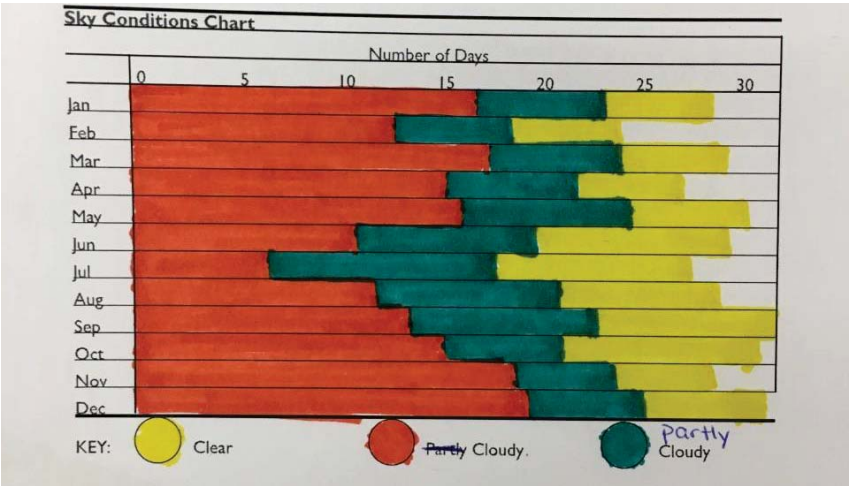
Sky Conditions

-Moscow in general is mostly cloudy

-Average of 15-20 days per month are cloudy

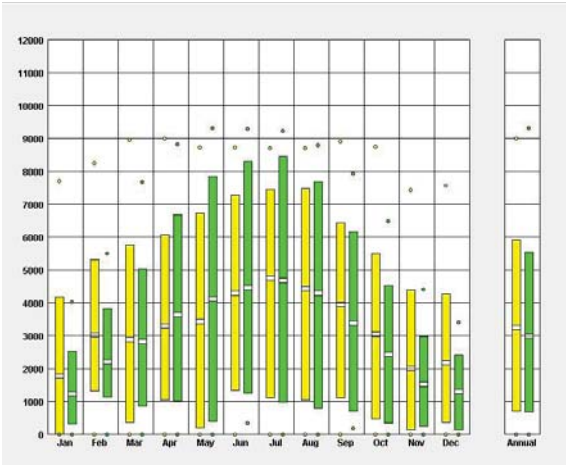
-Partly cloudy and clear days are mostly equal

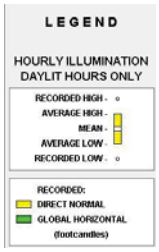
-Daylighting solutions must accommodate this



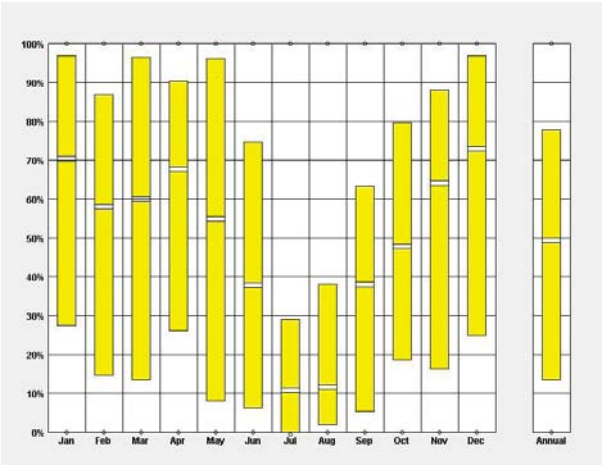
Question C

Climate Consultant Analysis





Annual Luminance = 3200 footcandles



Annual Average Cloud Cover = 49%

Question C

Design Proposal

-Existing lighting conditions are excellent due to north- and west-facing windows

-The problem areas are south adjoining wall and back southeast corner

-We propose to add skylights near south wall above dressing rooms

-Add toplighting in back southeast corner

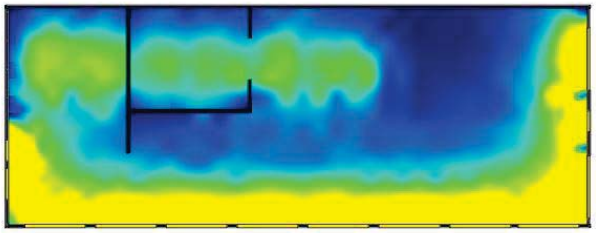
-Replace incandescent bulbs with more energy-efficient LEDs

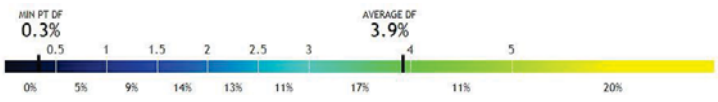
Question C

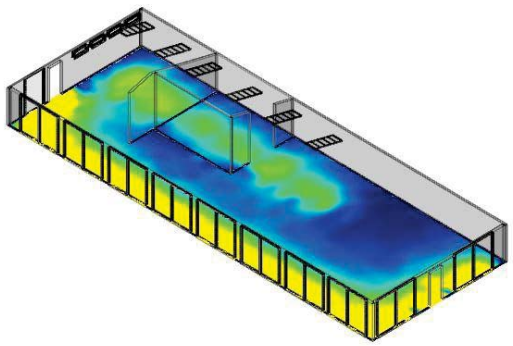
Design Proposal Daylighting Factors

-The design proposal causes the space to be much more well lit

-Added daylighting will save even more money than now

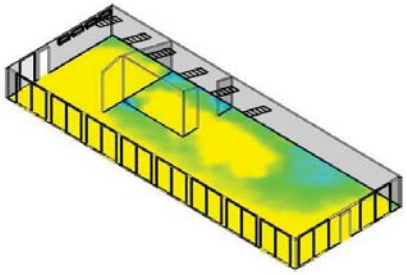






Question C

June 21



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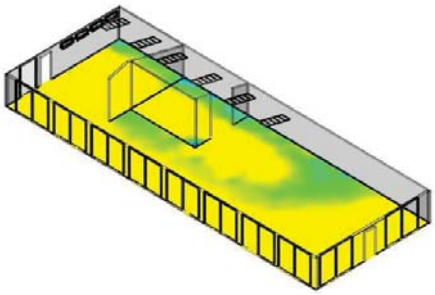
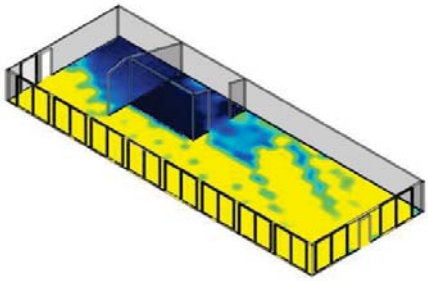


1 pm

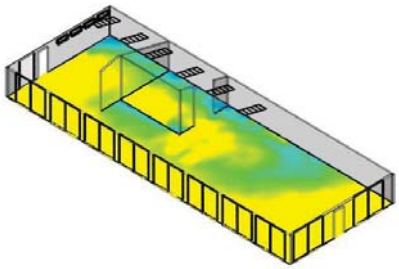


6 pm

Proposal effectively daylights entire space for the majority of the day, except in evening when adjacent building shadows corner.

Question C

September 21



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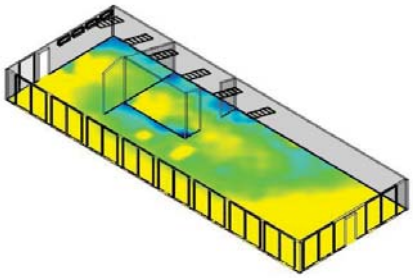

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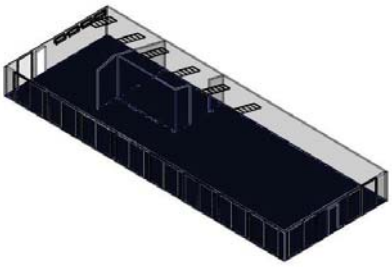


6 pm

The space is most well lit during the morning hours, while it gets increasingly well lit as the day goes on - no light in at 6 pm.

Question C

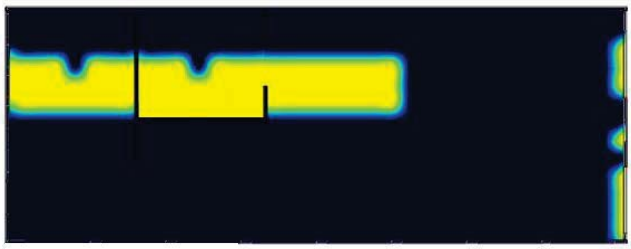
Design Proposal Direct Sunlight

-The proposed skylights let in a lot of direct sunlight

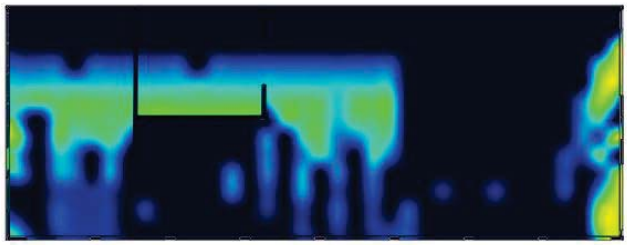
-(so be prepared to wear a ball cap ;))

-The dressing room and back southeast corner will now be adequately lit

-The light diffuses more evenly during the winter



Summer



Winter

Question C

Design Proposal Light Fixture Analysis

LED bulbs: $0.0041 daily, $1.46 daily, 4 W. 180 bulbs x $1.46 = **$262.80 per year**. 180 x 4W = **720 W**.

Existing Lighting: 7.880 kW x 9 hours/day x 260/year = **18,439.2 kW/year**

Design Proposal with LED Replacements: $262.80 + $705.60 = **$968.84 per year**

720 W + 680 W = **1400 W**

1.400 kW x 2.5 hrs/day x 260/yr = **910 kW/year**

Conclusion

The Storm Cellar as it exists currently is already very effectively daylit; its only major issues were the adjoining south wall, the back southeast corner, and the poorly lit dressing rooms.

We added skylights and toplighting in the back, as well as implementing LED light bulbs, so as to further increase lighting effectiveness and energy efficiency.

This change provided energy savings to allow an already excellent space to become even better.