University of California Santa Barbara

Student Resource Building

Technical Assignment 1: Addendum

"Existing Conditions Daylight Studies"

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Executive Summary

The following addendum will discuss how daylight currently affects interior light levels of the three interior spaces of the University of California Santa Barbara Student Resource Building (SRB). They will be presented in this order:

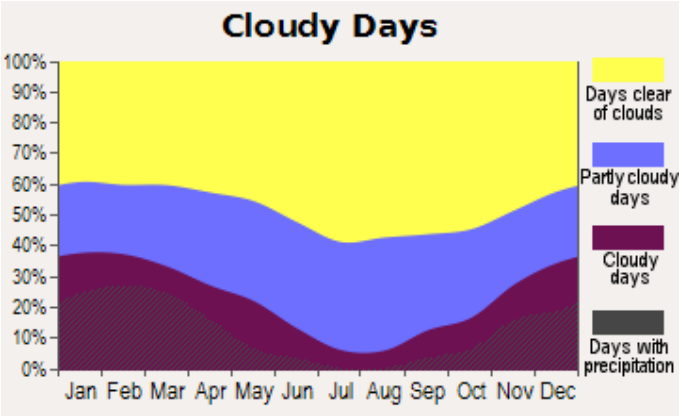
Section 1 Daylight Elements and Study Parameters
Section 2 Forum
Section 3 Multi Purpose Room
Section 4 Student Resource Center

An analysis of each space will consist of following:

a. Overview
b. Daylight Renderings
c. Numerical Summary
d. Conclusion

All data was generated using AGI32 v1.92.

Here is the percentage breakdown of the different sky conditions in Santa Barbara, CA over a year:



(Source: City-Data.com)

Section 1: Daylight Elements and Study Parameters

The following is a tabulation of the performance of the currently proposed daylight elements utilized in this building.

Window Data

Window Type	Properties
Operable Windows	U Factor: 0.43-0.62 Solar Transmittance Coefficient: 32-45
Sliding Windows	U Factor: 0.49-0.57 Solar Transmittance Coefficient: 32-35

Glazing Data

Glass Type	Properties
GL1: Insulating Vision Glass w/ low E *(General application on South and West Façade)*	Transmittance: UV: 18% Visible Light: 73% Total Solar Energy: 38% Reflectance: Visible Light: 12% Total Solar Energy: 40% U-Values: Winter Night-time: 0.29 Summer Day-time: 0.28 Shading Coefficient (SC): 0.44 Solar Heat Gain Coefficient (SHGC): 0.38 Light to Solar Gain: 1.84
GL2: Insulating Vision Glass w/o low E *(Throughout)*	(see GL1)
GL3: ¼" Clear Monolithic *(Throughout)*	Visible Light Transmittance: 1.02 U-Values: Winter: 1.02 Summer: 0.93 SHGC: 0.61 SC: 0.71 Outdoor Visible Light Reflectance: 8%

Listed here are the parameters used in AGI32 to conduct the following analysis.

Location	Santa Barbara
Coordinates	Longitude: 34.26 Degrees (North) Latitude: 119.5 Degrees (West)

Section 2: Forum

2a. Overview

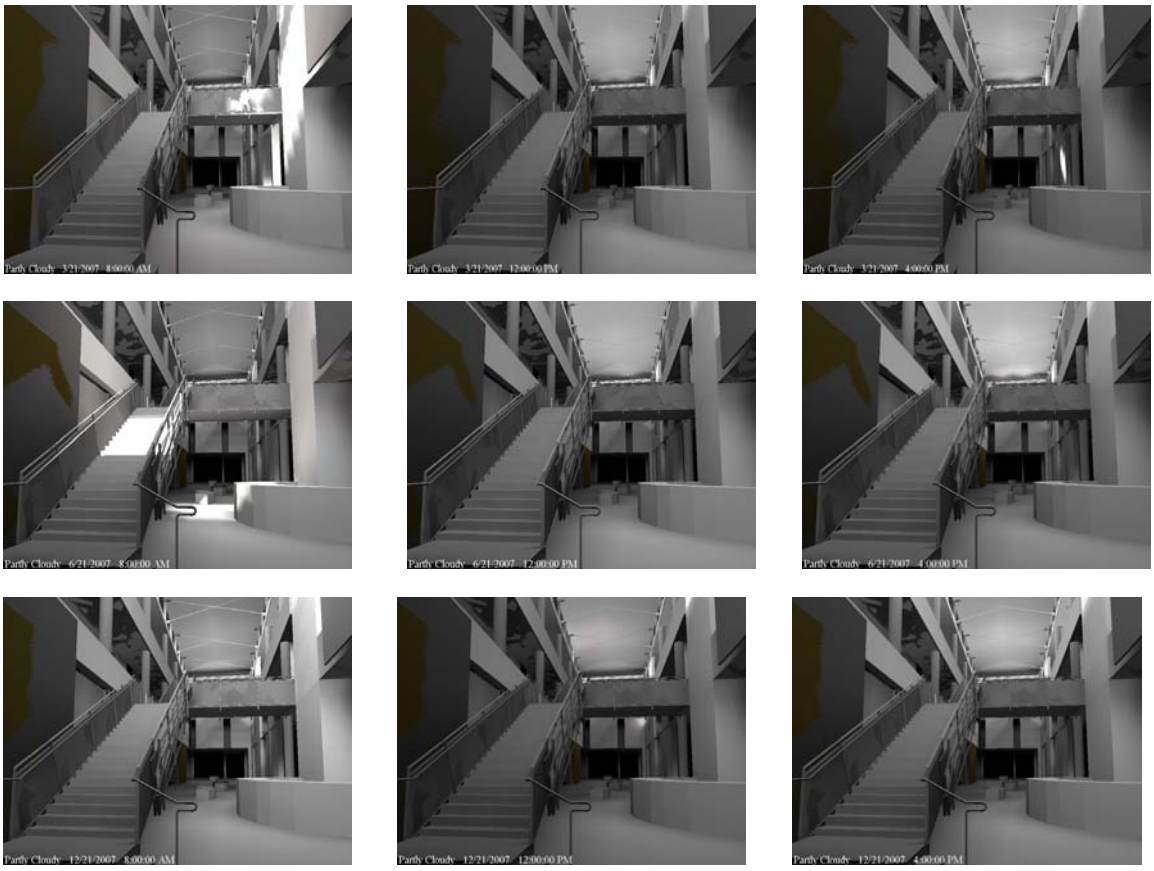
Daylight data was collected between 8am to 6pm on March 21st, June 21st and December 21st under the three standard IES sky conditions in Santa Barbara, CA.

For a more in-depth description of this space, please consult the main document for this technical assignment.

2b. Daylight Study Results

Clear Sky Renderings (8 am, 12 pm and 4 pm)

Partly Cloudy Renderings (8 am, 12 pm and 4 pm)



Overcast Rendering (Typical)

2c. Numeric Summary

Notes: 1. All values in fc
2. Workplane @ 2'-6" AFF
3. Overcast values typical for that month
4. Sun below horizon at 6pm on 12/21.

Analysis Area: 1st Floor

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	34.8	2746.4	3.2	18.4	612.5	2.2			
	10:00 AM	21.7	4321.8	2.8	22.7	1914.6	3.0			
	12:00 PM	9.8	27.0	1.9	16.2	62.7	3.5	6.7	32.0	1.1
	2:00 PM	8.1	18.3	1.9	12.0	38.6	3.1			
	4:00 PM	9.6	37.1	2.0	7.7	19.8	1.8			
	6:00 PM	1.4	4.1	0.8	0.4	1.2	0.5			
6.21	8:00 AM	243.5	4937.8	3.6	106.7	1908.5	3.5			
	10:00 AM	69.1	5381.2	3.2	51.8	2809.7	4.0			
	12:00 PM	11.0	31.3	2.0	19.1	75.3	4.2	8.0	38.1	1.3
	2:00 PM	22.5	7985.4	2.0	21.3	4092.1	3.9			
	4:00 PM	80.5	4914.5	2.1	37.2	1862.8	2.5			
	6:00 PM	6.9	720.9	1.4	3.8	54.1	0.9			
12.21	8:00 AM	10.3	20.9	1.6	5.0	18.3	0.7			
	10:00 AM	13.6	28.9	2.4	11.9	42.2	1.9			
	12:00 PM	19.2	4415.4	2.7	14.2	1461.2	2.4	4.4	20.9	0.7
	2:00 PM	9.7	20.1	2.3	8.1	24.2	1.9			
	4:00 PM	5.5	11.1	1.3	2.4	7.2	0.6			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: 1st Floor Counter

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	117.6	157.1	35.0	74.4	82.8	41.4			
	10:00 AM	110.1	4285.7	33.3	109.2	1898.0	60.0			
	12:00 PM	26.1	31.8	19.4	57.9	73.4	42.0	27.4	35.5	18.3
	2:00 PM	18.6	21.1	13.8	36.8	44.6	28.0			
	4:00 PM	14.2	15.3	9.1	19.4	22.3	14.8			
	6:00 PM	4.2	4.5	2.7	1.2	1.3	0.9			
6.21	8:00 AM	1890.8	3509.8	41.2	776.8	1395.5	57.1			
	10:00 AM	53.7	74.3	32.7	99.0	129.9	65.5			
	12:00 PM	28.5	35.0	20.5	66.4	84.6	46.4	32.7	42.3	21.8
	2:00 PM	20.6	23.7	14.7	44.0	53.6	32.7			
	4:00 PM	16.1	17.7	10.6	26.5	31.0	19.7			
	6:00 PM	11.6	12.6	7.6	10.3	11.9	7.4			
12.21	8:00 AM	22.9	25.8	15.4	20.4	23.0	15.8			
	10:00 AM	31.3	35.0	23.5	43.7	52.3	33.7			
	12:00 PM	26.3	30.0	18.7	38.5	45.9	28.6	17.9	23.2	11.9
	2:00 PM	20.2	23.5	12.8	24.0	27.9	18.4			
	4:00 PM	10.9	12.3	6.6	7.2	8.3	5.6			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: 2F Pedestrian Bridge

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	31.9	50.6	13.5	22.1	45.3	7.0			
	10:00 AM	17.5	29.3	7.2	24.1	47.8	7.6			
	12:00 PM	16.7	24.7	7.9	22.8	40.0	8.5	7.8	16.2	2.5
	2:00 PM	14.7	21.6	7.0	18.0	29.8	7.1			

	4:00 PM	10.5	16.8	4.6	10.0	16.8	3.9			
	6:00 PM	2.3	4.4	1.5	0.5	0.8	0.3			
6.21	8:00 AM	28.9	58.5	8.5	31.3	71.0	7.8			
	10:00 AM	20.5	34.7	8.8	30.0	60.1	9.8			
	12:00 PM	18.2	27.3	8.8	26.4	47.1	10.1	9.3	19.3	2.9
	2:00 PM	16.2	23.7	8.0	21.6	36.2	8.8			
	4:00 PM	12.4	19.1	5.8	14.2	24.0	5.8			
	6:00 PM	7.9	13.3	3.4	5.6	9.7	2.2			
12.21	8:00 AM	14.6	25.4	4.3	7.2	15.0	1.9			
	10:00 AM	22.0	32.1	7.2	17.2	30.9	5.1			
	12:00 PM	23.2	32.1	7.8	18.8	30.0	6.1	5.1	10.6	1.6
	2:00 PM	20.1	28.0	6.6	13.4	21.3	4.5			
	4:00 PM	10.8	17.5	3.2	3.7	6.4	1.3			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: 3F Pedestrian Bridge

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	13.9	22.6	8.4	15.4	27.0	7.9			
	10:00 AM	18.7	24.4	13.1	25.8	38.6	14.7			
	12:00 PM	21.1	26.8	15.2	29.7	42.2	17.4	11.8	21.9	4.4
	2:00 PM	18.9	24.1	13.5	25.4	37.0	14.7			
	4:00 PM	13.9	19.9	9.7	15.0	24.5	8.1			
	6:00 PM	2.6	4.9	1.4	0.5	1.3	0.1			
6.21	8:00 AM	17.1	29.1	10.2	24.2	46.0	11.4			
	10:00 AM	21.4	29.8	14.6	32.6	54.2	17.0			
	12:00 PM	22.7	30.0	16.1	34.7	55.0	18.9	14.1	26.2	5.3
	2:00 PM	20.9	28.7	14.6	31.1	51.3	16.6			
	4:00 PM	16.2	25.3	10.7	21.8	40.3	10.8			
	6:00 PM	15.6	37.3	9.5	9.2	20.1	4.2			
12.21	8:00 AM	29.4	54.8	14.8	7.4	11.1	4.1			
	10:00 AM	21.7	40.4	14.4	19.1	33.7	11.0			
	12:00 PM	280.6	3117.1	17.1	107.7	1055.4	13.7	7.7	14.4	2.9
	2:00 PM	20.8	46.4	14.1	17.5	32.3	10.1			
	4:00 PM	17.4	22.6	12.0	5.5	8.1	3.0			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: 2F Corridor

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	32.7	1253.1	1.1	13.0	294.8	1.0			
	10:00 AM	5.6	16.0	1.2	9.2	29.1	1.1			
	12:00 PM	5.2	12.5	1.3	8.8	25.4	1.3	4.3	15.6	0.5
	2:00 PM	4.7	11.1	1.3	7.2	19.7	1.2			
	4:00 PM	24.9	651.3	1.1	9.8	173.6	1.1			
	6:00 PM	1.0	2.6	0.8	11.1	162.0	0.8			
6.21	8:00 AM	9.0	29.8	1.2	12.2	41.8	1.1			
	10:00 AM	6.8	19.7	1.2	12.5	41.6	1.2			
	12:00 PM	6.0	14.9	1.4	11.1	34.1	1.3	5.2	18.6	0.8
	2:00 PM	5.4	13.0	1.4	9.4	26.9	1.3			
	4:00 PM	4.7	11.0	1.1	6.8	18.9	1.1			
	6:00 PM	7.5	518.5	1.0	3.2	43.1	0.9			

12.21	8:00 AM	4.3	12.7	1.2	2.7	8.7	1.1			
	10:00 AM	5.5	14.5	1.3	5.8	16.9	1.2			
	12:00 PM	5.4	14.6	1.3	6.1	16.5	1.3	2.8	10.2	0.3
	2:00 PM	4.7	12.5	1.1	4.6	12.0	1.0			
	4:00 PM	3.1	7.8	1.0	1.5	4.2	1.0			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: 3F Corridor

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	10.6	24.9	0.8	9.6	24.4	1.5			
	10:00 AM	9.7	22.6	0.9	14.1	37.4	1.9			
	12:00 PM	10.3	23.1	1.0	15.5	40.5	1.9	5.3	15.5	0.8
	2:00 PM	9.5	21.0	1.0	13.6	35.1	1.6			
	4:00 PM	16.4	1108.7	0.8	10.7	289.6	1.0			
	6:00 PM	1.8	3.9	0.3	1.1	1.3	0.8			
6.21	8:00 AM	11.1	26.9	1.0	13.9	37.7	2.1			
	10:00 AM	10.5	23.5	1.0	16.6	42.5	2.5			
	12:00 PM	10.5	21.7	1.1	16.9	42.2	2.3	6.3	18.5	1.0
	2:00 PM	9.9	20.3	1.0	15.4	38.5	1.9			
	4:00 PM	27.1	2464.1	0.9	15.4	38.5	1.9			
	6:00 PM	9.3	368.9	0.5	5.3	33.1	0.9			
12.21	8:00 AM	19.7	40.2	4.3	4.6	11.1	1.0			
	10:00 AM	67.1	1192.5	2.9	10.3	35.8	1.4			
	12:00 PM	12.1	31.3	0.9	12.7	35.3	1.4	3.4	10.2	0.5
	2:00 PM	36.9	1144.2	0.8	16.4	302.6	0.9			
	4:00 PM	12.8	31.1	0.5	3.3	8.3	0.5			
	6:00 PM	-	-	-	-	-	-	-	-	-

2d. Conclusion

As expected, the greatest amount of light reaches the ground floor during the summer months. The same can be said for the corridors and pedestrian bridges on the upper levels. The data also suggest that there is sufficient daylight reaching the counter on the ground floor for most days in the year.

The studies assume that the operable clerestory windows are closed. This may not be the case, as most of the building was designed to make use of natural ventilation by keeping those open for most of the year. Therefore, we can expect a slightly higher level of daylight penetration in this space if the windows were open.

Section 3: Multipurpose Room

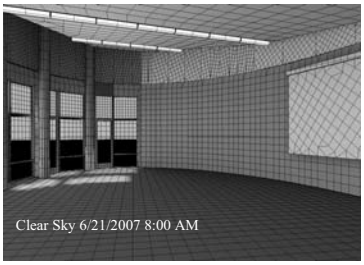
3a. Overview

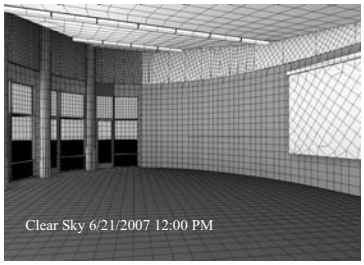
Daylight data was collected between 8am to 6pm on March 21st, June 21st and December 21st under the three standard IES sky conditions in Santa Barbara, CA.

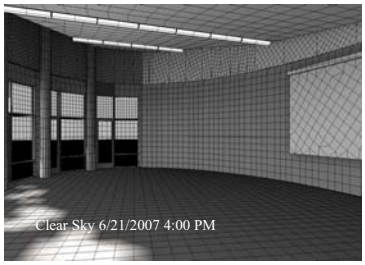
For a more in-depth description of this space, please consult the main document for this technical assignment.

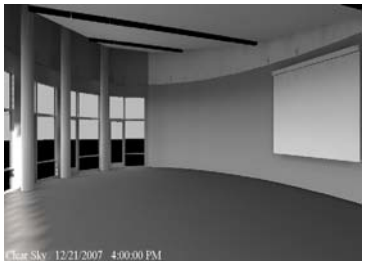
3b. Daylight Study Results

Clear Sky Renderings (8 am, 12 pm and 4 pm)

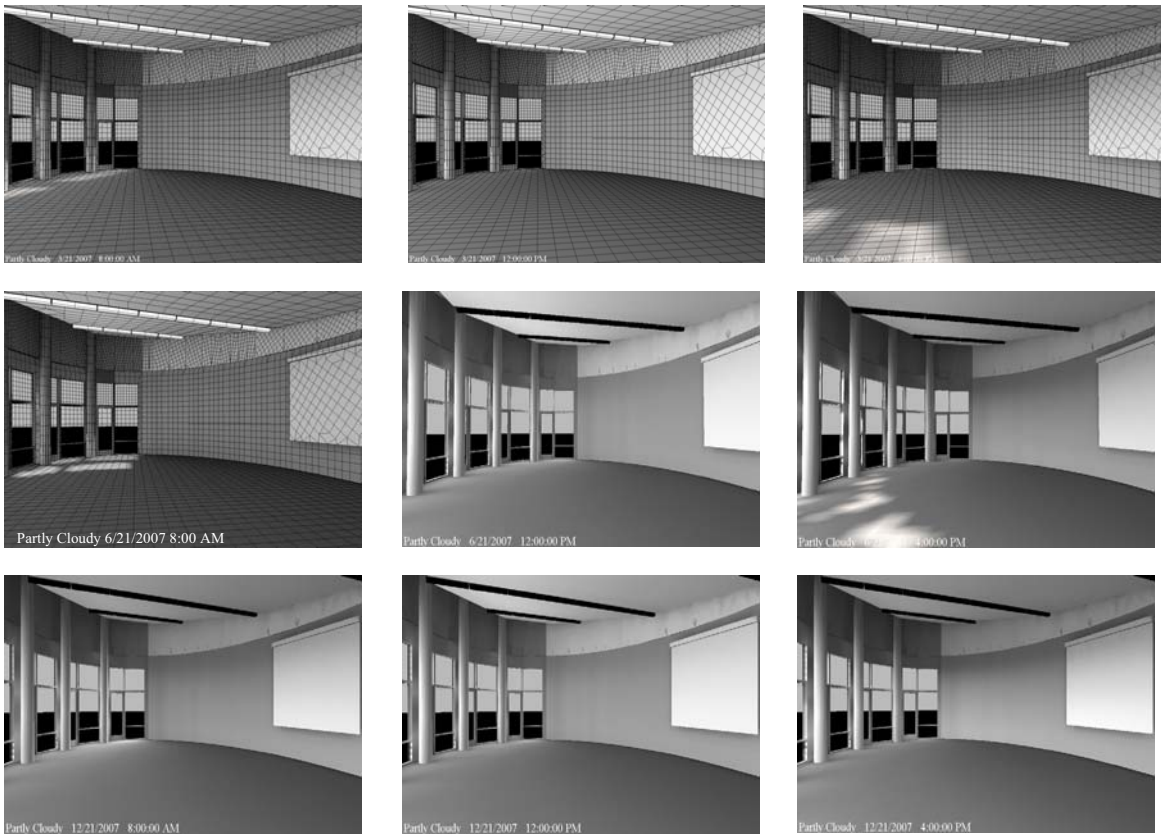




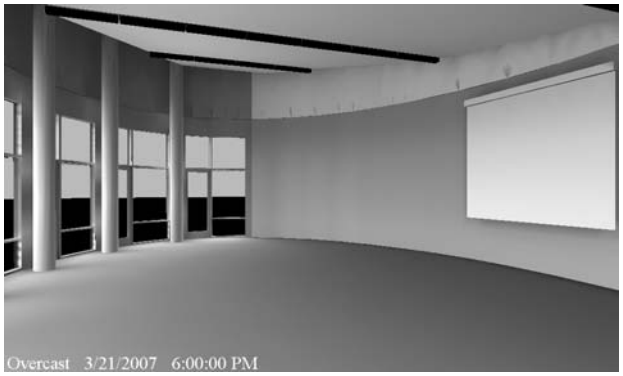




Partly Cloudy Renderings (8 am, 12 pm and 4 pm)



Overcast Rendering (Typical)



3c. Numeric Summary

Notes: 1. All values in fc
2. Workplane @ 2'-6" AFF
3. Overcast values typical for that month
4. Sun below horizon at 6pm on 12/21.

Analysis Area: Floor Plane

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	128.9	2822.9	7.4	77.3	692.3	8.1			
	10:00 AM	80.7	3039.0	9.7	98.7	1666.1	11.6			
	12:00 PM	67.3	7695.3	10.6	106.2	3825.4	12.2	2.1	7.5	1.6
	2:00 PM	71.9	3101.1	10.6	112.1	2903.0	10.4			
	4:00 PM	154.9	3195.8	8.6	105.7	890.7	6.1			
	6:00 PM	17.1	52.9	1.4	5.3	19.3	0.3			
6.21	8:00 AM	189.1	4938.9	9.0	157.2	1890.3	14.2			
	10:00 AM	118.8	8107.3	10.5	159.6	4361.8	16.1			
	12:00 PM	66.3	162.7	11.4	143.5	456.1	15.8	2.5	8.9	1.2
	2:00 PM	123.5	8122.6	11.9	175.3	4452.4	14.0			
	4:00 PM	310.0	4978.2	10.4	213.7	2004.4	10.3			
	6:00 PM	258.4	1068.8	7.1	76.5	245.0	3.8			
12.21	8:00 AM	35.9	430.9	3.9	25.2	135.0	3.0			
	10:00 AM	43.9	1400.5	6.5	55.0	471.9	6.4			
	12:00 PM	47.3	4463.1	7.5	65.1	1504.8	7.2	1.4	4.9	1.1
	2:00 PM	51.5	3260.6	7.4	59.6	919.9	5.4			
	4:00 PM	41.0	450.5	3.9	24.9	114.9	1.8			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: Work Plane

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	117.0	2845.8	9.8	66.9	730.0	10.7			
	10:00 AM	75.8	6265.1	12.7	86.4	2724.9	15.3			
	12:00 PM	59.4	202.8	13.9	90.4	447.1	16.2	1.8	8.6	1.3
	2:00 PM	70.1	6497.9	14.0	95.9	2892.7	13.7			
	4:00 PM	132.6	1946.0	11.3	91.2	875.7	8.1			
	6:00 PM	15.2	62.6	1.9	4.6	21.8	0.4			
6.21	8:00 AM	160.6	2707.1	11.9	133.3	1505.9	18.7			
	10:00 AM	87.6	3921.3	13.9	130.2	2560.9	21.2			
	12:00 PM	66.8	9157.8	12.9	123.7	552.3	20.9	2.1	10.2	1.6
	2:00 PM	106.6	3835.3	15.7	149.1	2450.6	18.5			
	4:00 PM	256.1	4963.5	13.9	179.3	1482.6	13.5			
	6:00 PM	259.2	1058.2	9.4	68.7	277.0	5.0			
12.21	8:00 AM	33.5	601.2	5.1	21.8	166.1	3.9			
	10:00 AM	41.6	3405.8	8.6	48.1	937.0	8.5			
	12:00 PM	41.1	140.7	9.9	55.8	276.9	9.5	1.2	5.6	0.9
	2:00 PM	50.1	3235.2	9.8	52.5	878.0	7.2			
	4:00 PM	38.6	420.8	5.2	21.6	128.2	2.4			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: Projector Screen *(vertical illuminance data)*

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	53.0	62.2	40.5	39.7	52.7	24.3			
	10:00 AM	80.7	82.5	76.8	72.3	83.2	57.1			
	12:00 PM	90.5	92.9	84.6	87.3	97.7	71.8	1.0	1.3	0.6
	2:00 PM	80.2	82.7	75.7	81.2	97.6	59.6			
	4:00 PM	58.5	68.9	42.8	54.5	77.0	27.9			
	6:00 PM	85.6	87.7	80.7	3.8	6.1	1.1			
6.21	8:00 AM	71.3	75.2	62.6	70.9	91.2	46.6			
	10:00 AM	92.1	95.1	84.9	100.6	116.6	78.8			
	12:00 PM	100.0	104.5	89.3	113.7	129.6	91.4	1.1	1.5	0.7
	2:00 PM	94.7	97.6	89.9	110.6	135.7	79.0			
	4:00 PM	82.9	95.7	63.4	85.7	103.9	62.7			
	6:00 PM	127.1	1608.2	27.3	107.1	123.1	85.1			
12.21	8:00 AM	29.6	42.4	14.1	15.4	21.8	8.1			
	10:00 AM	56.6	65.1	43.7	40.3	49.9	28.2			
	12:00 PM	64.5	69.9	54.4	51.1	61.3	37.7	0.6	0.8	0.4
	2:00 PM	53.6	61.3	41.5	15.4	21.8	8.1			
	4:00 PM	26.1	38.2	11.3	16.4	24.5	6.9			
	6:00 PM	-	-	-	-	-	-	-	-	-

3d. Conclusion

Data collected suggest that there is an ample amount of daylight in this space. As the glazing is facing north, daylight levels significantly drop during an overcast sky condition. Although daylight levels seem to be high on the workplane and on the projector screen's surface, it can be assumed that the curtains in the room will be drawn when the needs of the space demand that both surfaces need to be used.

Section 4: Student Resource Center

4a. Overview

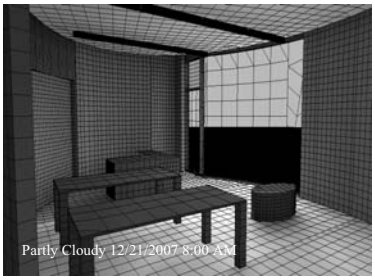
Daylight data was collected between 8am to 6pm on March 21st, June 21st and December 21st under the three standard IES sky conditions in Santa Barbara, CA.

For a more in-depth description of this space, please consult the main document for this technical assignment.

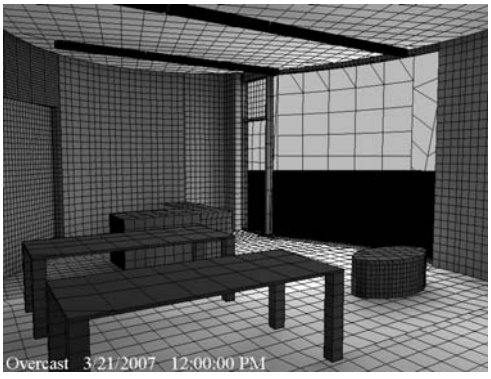
4b. Daylight Study Results

Clear Sky Renderings (8 am, 12 pm and 4 pm)

Partly Cloudy Renderings (8 am, 12 pm and 4 pm)



Overcast Rendering (Typical)



4c. Numeric Summary

Notes: 1. All values in fc
2. Workplane @ 2'-6" AFF
3. Overcast values typical for that month
4. Sun below horizon at 6pm on 12/21.

Analysis Area: Floor Plane

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	381.8	2834.9	6.4	166.3	723.9	4.7			
	10:00 AM	746.2	6475.0	15.1	462.8	2999.9	12.4			
	12:00 PM	829.5	7900.0	17.9	561.8	4124.9	16.4	64.4	349.3	2.8
	2:00 PM	498.2	3345.3	12.2	344.8	1975.1	12.6			
	4:00 PM	200.4	3171.9	5.7	120.1	838.9	6.0			
	6:00 PM	11.7	63.8	0.8	3.9	23.5	0.3			
6.21	8:00 AM	137.6	4933.3	5.5	141.5	1883.8	5.7			
	10:00 AM	262.2	8211.9	8.8	266.1	4576.4	10.1			
	12:00 PM	191.2	3142.8	8.9	244.3	2392.3	11.5	76.7	416.1	3.3
	2:00 PM	215.0	3955.5	7.0	227.4	2626.3	9.9			
	4:00 PM	280.8	5048.5	5.0	181.6	2199.6	6.3			
	6:00 PM	105.2	562.0	2.3	39.3	285.3	2.1			
12.21	8:00 AM	175.4	497.5	3.6	54.7	211.6	2.2			
	10:00 AM	785.0	2012.6	15.6	319.7	986.1	9.4			
	12:00 PM	884.5	2570.8	30.5	421.8	1381.0	17.8	42.2	229.0	1.8
	2:00 PM	445.5	3284.1	19.0	205.5	883.6	15.0			
	4:00 PM	60.1	333.5	6.9	33.8	140.4	2.8			
	6:00 PM	-	-	-	-	-	-	-	-	-

Analysis Area: Work Plane

Date	Time	Clear Sky			Partly Cloudy			Overcast		
		Avg	Max	Min	Avg	Max	Min	Avg	Max	Min
3.21	8:00 AM	76.2	104.1	55.1	70.1	100.1	48.2			
	10:00 AM	181.9	2452.2	98.5	170.3	1173.9	102.6			
	12:00 PM	219.5	2080.9	95.4	210.4	1153.0	112.9	36.9	57.1	22.4
	2:00 PM	76.2	104.1	55.1	123.8	174.7	81.9			
	4:00 PM	46.9	63.8	34.2	59.5	86.5	40.0			
	6:00 PM	9.2	12.7	6.9	2.8	4.2	2.0			
6.21	8:00 AM	51.2	69.9	37.1	74.2	107.6	50.3			
	10:00 AM	75.1	102.8	53.5	118.3	171.7	79.1			
	12:00 PM	44.1	60.2	32.1	125.2	180.6	82.8	43.9	68.0	26.7
	2:00 PM	57.8	79.2	41.3	103.1	151.5	68.4			
	4:00 PM	44.5	64.0	32.2	65.1	94.5	43.8			
	6:00 PM	186.0	642.0	19.6	35.7	74.1	16.1			
12.21	8:00 AM	212.4	325.6	128.9	43.7	62.2	30.4			
	10:00 AM	925.6	1418.0	114.6	328.6	494.0	89.7			
	12:00 PM	787.8	1278.4	657.5	357.8	558.2	282.8	24.2	37.5	14.7
	2:00 PM	471.1	323.7	28.9	182.4	322.8	64.2			
	4:00 PM	45.0	182.2	25.9	25.6	36.8	17.8			
	6:00 PM	-	-	-	-	-	-	-	-	-

4d. Conclusion

Based on collected data for the floorplane, there seems to be an excessive amount of daylight in this room throughout the year. This can be attributed to the higher amount of light nearer the window, hence skewing the values. For the workplane, only data from surfaces where proposed by the furniture layout were considered. In this scenario, although light levels were adequate during most parts of the year, it was excessive during the winter months when the sun angle was a lot lower. The room would benefit from the installation of a daylight shading device and/or the utilization of glazing with a lower visible light transmittance.