Introduction

Grand Oaks is an Assisted Living Facility in the Washington, D.C. area that gives its residents the support they need while maintaining a home like environment. So, when I set out to develop a lighting program for this facility, I wanted to establish as much of a residential type atmosphere as possible. There are certain challenges given the fact that I am designing for older individuals, which as a result of their age, have issues with vision, of which, poor lighting design can affect. A few of the problems that the affect older individuals are: smaller pupils (which reduce the amount of light entering the eye), loss of ocular transparency (which scatters light and reduces the apparent contrast of objects), yellowing of the ocular media (which changes the colors of the visual field), loss of accommodation (which results in increased blur), and an increase in the prevalence of ocular disease. All of these issues contribute to the need for special attention to the lighting requirements of older persons. (IESNA: Lighting and the Visual Environment for Senior Living RP-28-98) The implementation of good lighting design can be thought of as a preventative medicine, by addressing the visual needs of those older individuals, I provide an environment that is safer for them to live in. With that said, there was some global design criterion that needed to be developed so that the lighting design could begin.

The structure of the Lighting Depth Report is somewhat different than the others, (Mechanical Feasibility Study, Cost Analysis of Geothermal Heat Pumps, and the Electrical Depth Report), such that I am not doing a direct comparison of the existing lighting conditions to new design conditions. In Technical Report #1, I provided a comprehensive existing conditions report that addressed the present issues with the current lighting design. After completing this report, I found that the facility was within code by meeting appropriate illuminance levels and power densities. The reason for not comparing the current design with the one that I am proposing is that lighting design in and of itself is an artistic notion and opinion. This subjective nature of lighting design is in and of itself a matter of opinion. So, in this report, I am going to refrain from making subjective complaints about the existing lighting design. I will base the effectiveness of my design on how well it adheres to the design criteria that I set forth. In the next section, you will find the "global" design criterion that is to be kept in mind for all spaces. Space by space design criteria will also be addressed given the specific needs of the individual spaces.

Design Criteria

- *Source: IES: RP-28-98 – Light and the Visual Environment for Senior Living*
- **The following design criterion is for a Senior Living Facility and the spaces that it includes. This criterion pertains specifically to the aging population and is meant to provide a basic understanding of their needs. Specific space criterion will also be developed in addition to this information.**

Elderly individuals can be divided into two categories:

- Those who suffer from pre-retinal scatter from corneal, lenticular, and citreal opacities. These persons may, and often do, have abnormal retinas. For such persons, increases in light may do more harm that good by increasing the amount of light available to be scattered.
- Those whose vision is limited by retinal dysfunction and whose acuity and contrast sensitivity are reduced. These persons often benefit from significantly higher light levels than are required for the normally sighted.

From the above two categories, it is apparent that special consideration will need to be taken when developing the design criteria and developing a lighting theme/program.

Quality of Lighting

- Freedom from glare (both disability glare and discomfort glare)
  - Reduce the amount of lighting entering the eye from areas within the central 10-15 degrees of the visual field which do not directly contribute to the visibility of the task
  - Avoid sources that are:
    - Bright
    - Large in area
    - Close to the line-of-sight
- Freedom from veiling reflections
- Freedom from flicker
- Adaptation control
  - Transitioning from light to dark is much greater the from dark to light
    - Lobbies must be brighter during the day and dimming during night time hours
- Spectral power distribution
  - “Bluer” produce less glare
  - Filtering the yellow wavelength can also increase the visual performance on contrast sensitivity and acuity tasks.

Lighting depth

- Daylight – psychological, physical health, and energy conserving benefits
  - Brightness
    - According to the IES, older individuals need more light given their somewhat sedentary lifestyles. The lack of daylight and high light levels throughout the day can disrupt the circadian rhythms and suppress the brain's nocturnal production of melatonin. This hormone, produced by the pineal gland, is secreted during the dark phase of the daily light/dark cycle, telling the body it is nighttime. As a result, older individuals have disrupted sleeping patterns and rely heavily on sleep medications. Sleep medication can have adverse affects such as memory loss, incoordination, and breathing disorders. The problem is apparent; so much attention will be given to increasing the light levels of the spaces throughout the day. Incorporation of day lighting and electric lighting will need to be integrating to increase light levels and lower energy consumption to comply with ASHRAE and /IESNA Standard 90.1 requirement for power consumption.
  - Depression and Mood Disorders
    - Lack of outdoor light exposure and sedentary lifestyles that keep older individuals indoors are factors that contribute to the depression and mood disorders
    - There is a need for exposure to bright light conditions for both psychological health as well as physical health and a feeling of well-being.
  - Vitamin D
    - Vitamin that is crucial for skeletal health
    - Obtained from both diet and the UVA radiation found in sunlight
    - Many older individuals do not receive enough in either diet or sunlight exposure.
    - Exposure to daylight and dietary supplements could help provide this essential nutrient.
  - Energy Conservation
    - With careful implementation, daylight can considerable lower energy consumption and should be a top priority of the utmost importance

Illuminance Values – *referenced from Health Care Facilities IES*

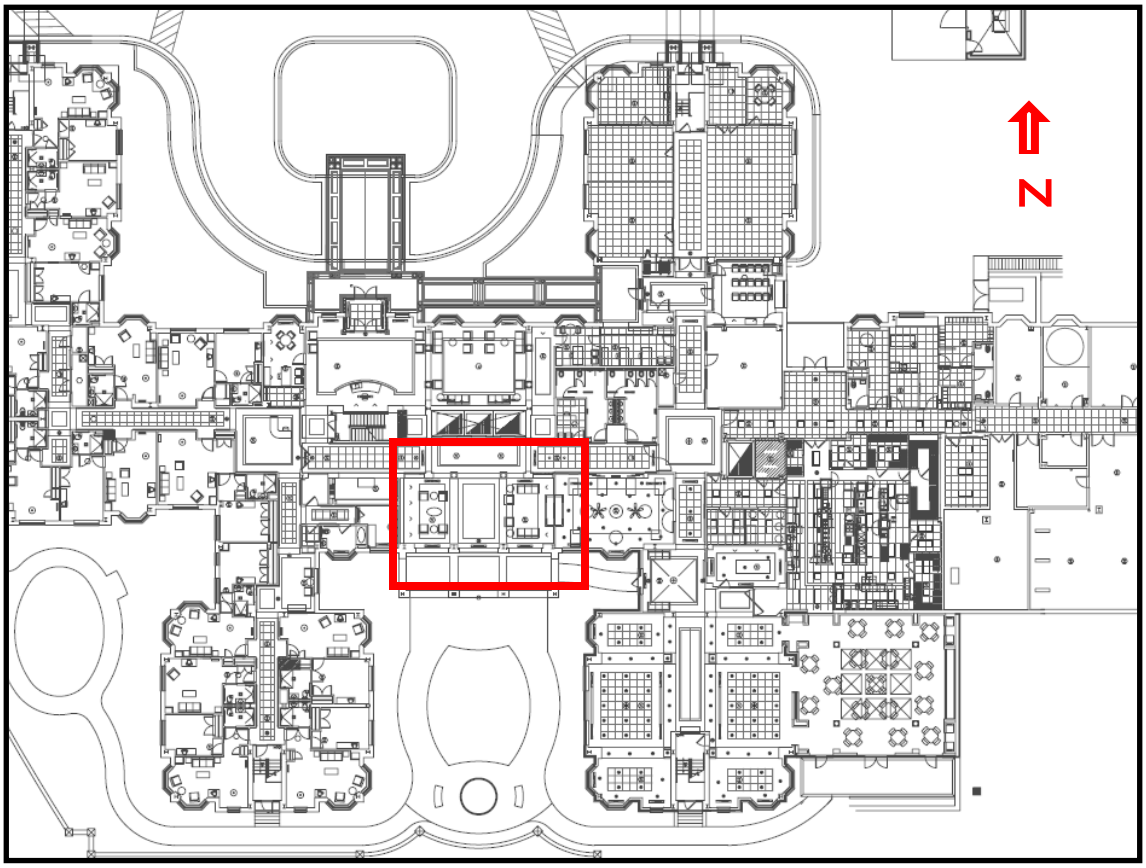
Areas	Ambient Light in Footcandles	Task light in footcandles
Exterior Entrance(Night)	**10**	
Interior Entry (Day)	**100**	
Interior Entry (Night)	**10**	
Exit Stairways and Landings	**30**	
Elevator Interior	**30**	
Parking Garage Entrance	**50**	
Exterior Walkways	**5**	
Administration (Active)	**30**	**50**
Active Area (Day Only)	**30**	**50**
Visitor Waiting (Day)	**30**	
Visitor Waiting (Night)	**10**	
Chapel or Quiet Area (Active)	**30**	
Dining (Active Hours)	**50**	
Hallways(Active Hours)	**30**	
Hallways (Sleeping Hours)	**10**	

Now that the global design criterion is addressed, I can begin to talk about the design of the individual spaces.

Living Room/Library

The first space that I am going to address in this lighting design is the Living Room. The intent of the lighting design in this space was to provide a warm, cozy, and comfortable environment. The nature of this space allows residents to have intimate conversations or congregate with friends for more of a social time. Some areas of interest are the bookshelves and the fireplace. So, when I developed schematics for the space, I thought of how I wanted to address this pieces and how the light would impact them.

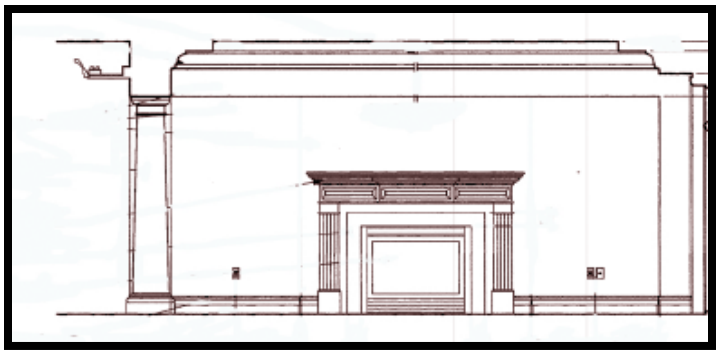
Space Details



The Living Room/Library is situated in the building such that it has a southern exposure. As you can see from the Floor plan, there is a covered porch that one can get to through the French doors, and have pleasant and relaxing view of the court yard area during well temperate days. The figure shown below is an elevation of the French doors on the southern end of the Living Room/Library.

Lighting depth

This is a section of the living room that shows the location of the fireplace and some of its details. This fireplace was of importance in the lighting design because it is a focal point in the room, of which attention needed to be drawn towards.



Space Specific Design Criteria

Target Illuminance Levels

Horizontal – 40-50fc
Vertical - 20 fc

Appearance of Space and Luminaires

Given the multipurpose nature of the space, the appearance of the space and luminaries needs to be both aesthetically pleasing and integrated for functionality. The functions of this space are such that residents could be in an intimate conversation or congregating as a group. Luminaries will be integrated as much as possible into the architecture so that there are clean lines throughout the space. The table lamps will be decorative in their given nature and be of a conservative look that fits within the space.

Color Appearance (and color contrast)

Color appearance will be heightened by the use of high CRI lamps so that as much of the visible spectrum as possible, will be recognized. In addition to the color rending of the lamps, I will also implement lamp temperature of 3000K. This warmer lamp temperature will complement the residential feel and intimacy of the space that I am trying to create. Skin tones will appear more healthy and overall look of the space will be warmer given this specified lamp temperature.

Daylight Integration and Control

The ability to use daylight will be considered only as an additive source to the electric lighting that is to be installed. With the large covered porch, direct sunlight penetration will not be an issue. I suggest that the window glass be view glass with a transmittance of 60%. There will be

dimming capabilities in the space, but it will be up to decide the facility to decide when and by how much they want to dim to the electric lighting in the space. The dimming will provide a greater aesthetic to the space rather than being looked at as a potential energy saver. The energy savings will be realized by adhering to ASHRAE 90.1 for power densities in the space.

Direct Glare/reflected

It will be important to avoid direct glare so that different illuminance ratios do not make the residents uncomfortable and potentially disoriented. Both the placement and type of luminaires used will address this concern and be of the variety that results in low levels of direct glare. Reflected Glare will be avoided by the use of matte finishes and furniture.

Power Allowance

ASHRAE/IESNA 90.1 –	1.2 watts/ft^2
Based on space by space method	1.0 watts/ft^2 – for decorative chandelier-type luminaries or sconces or for highlighting art or exhibit

With the listed design criteria, I could begin to develop a schematic design that would eventually be modeled in AGI.32 so that I could calculate the necessary illuminance values.

Schematic Design of the Space

During the brainstorming process I developed some schematic sketches of the living room space to show where I wanted to put the light, by which I could establish a hierarchy of objects within the space and draw a person's attention to any visual areas of interest. My thoughts during the schematic design were to add cove lighting to provide general diffuse, indirect illumination. The columns are highlight with wall sconces to make them more dramatic. The fireplace is washed with light with special highlight for framed artwork that could be placed above the mantel. Table lamps are added to provide that "home-like" environment and give more light at the work plane so that residents have the appropriate foot candle levels present for reading.

Lighting depth

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Now that I have an idea of what I want the space to look like, how I envision the overall aesthetic properties of the space, and various levels of hierarchy, I could begin my search for the perfect luminaires that could achieve the desired lighting affect. In addition, a 3-dimensional model of the space was created in AGI.32. The reflectance of the ceiling, walls, floor, and the like are provided below. These values as well as assumption went into the program to produce the lighting calculations.

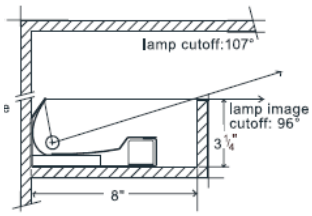
The surface materials of the space include:

- vinyl wall covering — reflectance = 50%
- Painted Plaster Ceiling — reflectance = 80%
- Carpet flooring — reflectance = 20%
- doors-painted — reflectance = 80%
- windows — reflectance = 10%(night)
  transmittance = 60%

The furnishings of the space include:

- Wooden tables — reflectance = 30%
- Leather Furniture — reflectance = 10%
- Book Cases – wood stain — reflectance = 10%
- Fireplace – wood — reflectance 10%

Lighting depth



COVE DETAIL

Lighting Layout

A3 – Prudential

B2 – ERCO

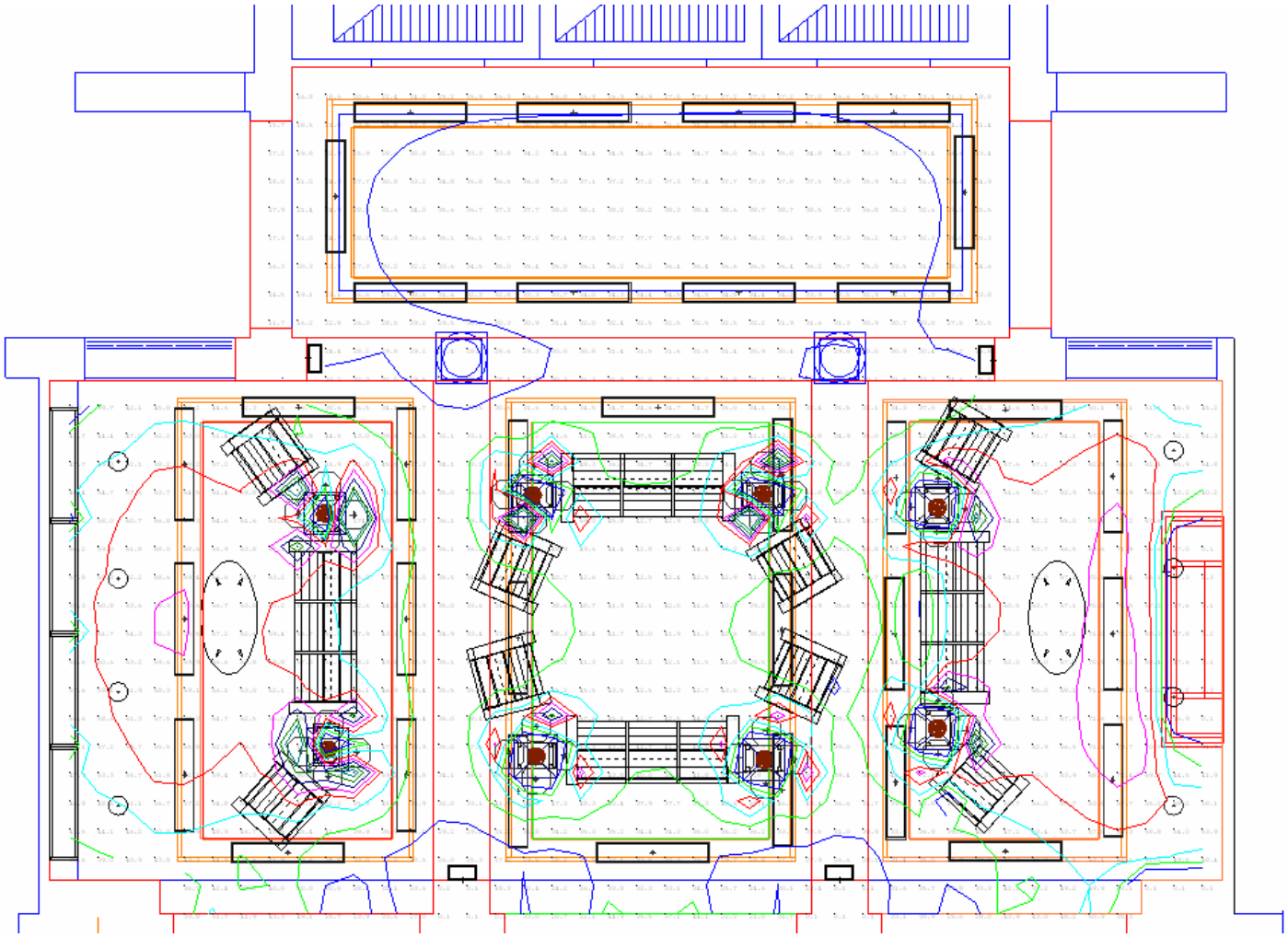
C2 – ERCO

D1 – Spilighting

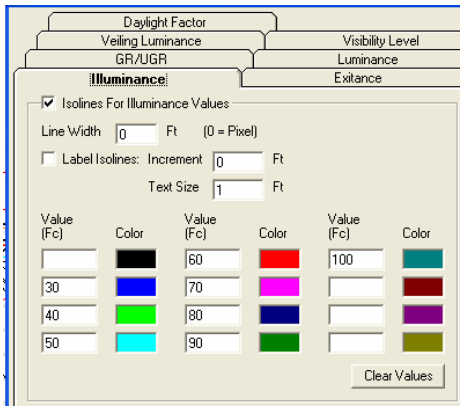
D2 – Target

Lighting depth

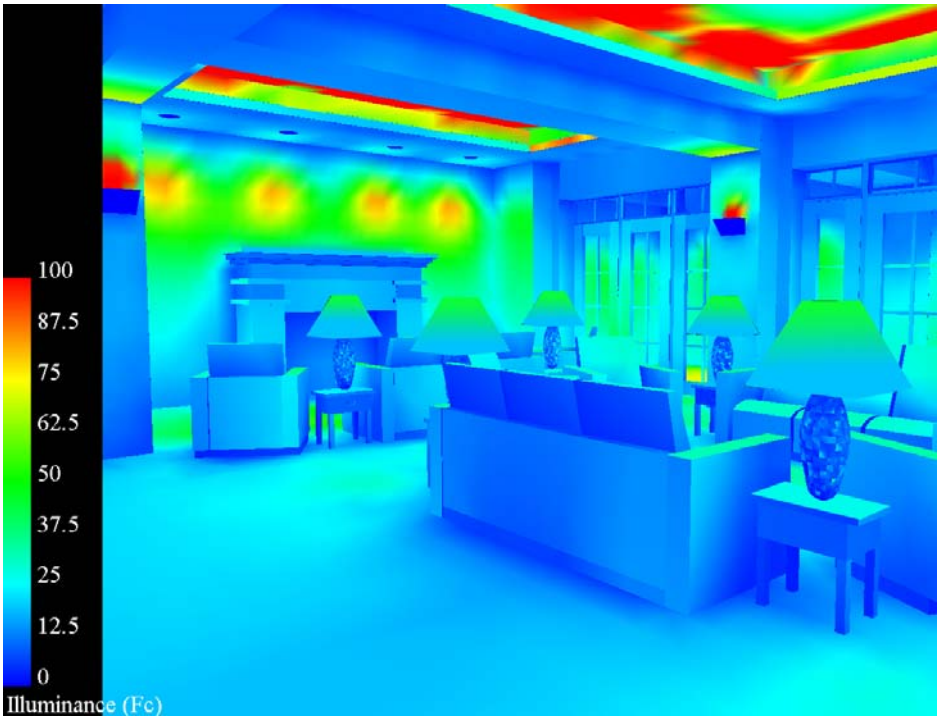
ISO-LINES

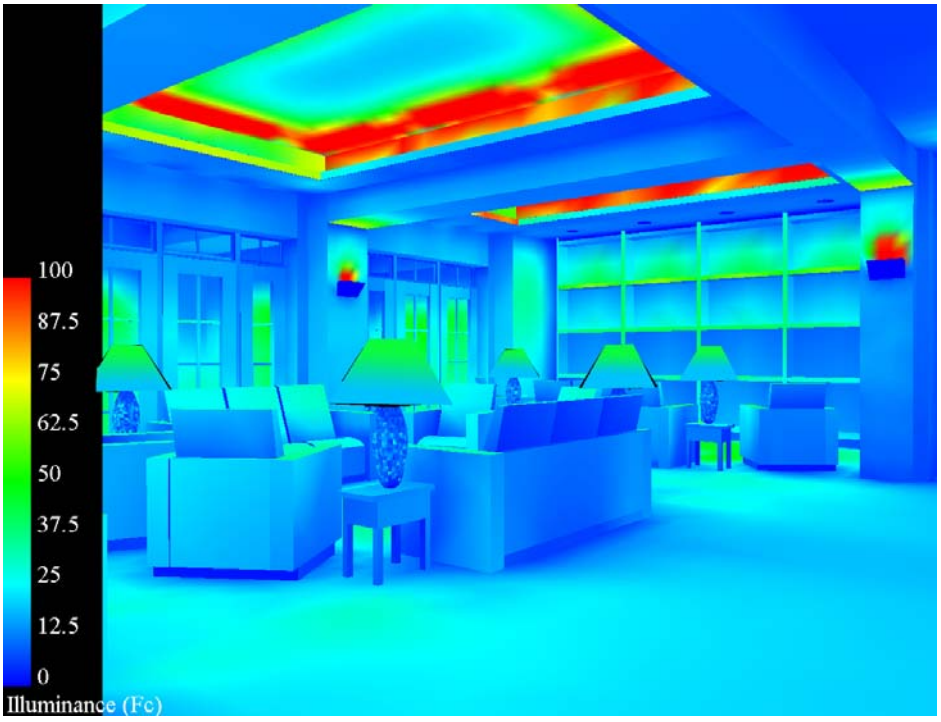


Average Illuminance ~ 43 fc



PSEUDO COLOR





Lighting depth

Power Density

LIVING ROOM/LIBRARY				
Main Room				
Luminaire	**#**	**ballast watts**	**total watts**	
B2	8	58.17	465.36	
A3	24	36	864	
D1	4	33.24	132.96	
D2	8	30	240	
			1702.32	watt total
			820	sq footage
			2.076	**w/sqft**
Elevator Lobby				
Luminaire	**#**	**ballast watts**	**total watts**	
A3	10	36	360	
			360	watt total
			250	sq footage
			1.44	**w/sqft**
Porch				
Luminaire	**#**	**ballast watts**	**total watts**	
C2	12	22.16	265.92	
			265.92	watt total
			516	sq footage
			0.51534884	**w/sqft**

ASHRAE 90.1 – Using the space-by-space method.

1.3 W/ft^2
1.0 W/^{ft2} decorative lighting

Exceptions to 9.2.2.3
(g) Lighting in spaces specifically designed for use by the visually impaired
9.6.3 Additional Interior Lighting Power
(a) For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance, such as chandelier-type luminaries or sconces of for highlighting are or exhibits, provided that the additional lighting powers hall not exceed 1.0W/ft^2 of such spaces

Branch Circuit Connect Load

SPACE	PANEL	V	CKT #	CONNECTED VA	CON'T LOAD(1.25)	Max amps/ckt
Living Room	L1E2	277	13	864.24	1080.3	<4436
Living Room	L1E2	277	15	1224	1530	<4437

Light Loss Factors

LIVING ROOM/LIBRARY									
LIGHT LOSS FACTORS									
TYPE	BF	CLEANING INTERVAL	MAINTENANCE CATEGORY	LLD	RSSD	LDD	TOTAL	ROOM CAVITY RATIO	
A3	1	CLEAN (12MONTHS)	VI	0.95	0.89	0.86	0.72713	h	10
B2	1	CLEAN (12MONTHS)	V	0.91	0.96	0.88	0.768768	L	40
C2	1	CLEAN (12MONTHS)	V	0.93	0.96	0.88	0.785664	W	20.5
D1	1	CLEAN (12MONTHS)	II	0.934	0.89	0.95	0.789697	RCR	3.689024
D2	1	CLEAN (12MONTHS)	III	0.91	0.94	0.9	0.76986		

RENDERINGS

The cove lighting in the space provides soft, indirect general illumination. The indirect portion helps to soften shadows and limit harsh contrast ratios. The bookshelf lighting is achieved with (2)-26W-CF wallwashers from ERCO. These luminaires wash the bookshelves with light and provide an average of 30 vertical footcandles. The lamps on the end tables are added to provide additional task lighting that may be needed for reading purposes. These table lamps make use of 30W screw base CF lamps. They will receive power from floor mounted outlets. The comment could be made that screw base CF lamps hurt the power factor on the electric bill. Given the fact that I am only using a total of (8) eight, I do not feel that will be any concern or problem. The wall sconces are implemented to add drama to the space and highlight the columns.

Lighting depth

The fireplace is illuminated with the same wall washers that are used for the book cases. You can see that there is scalloping on the wall, and to some, this may be an undesired affect. In this installation I feel that the scallops add romance to the space with the contrast between light and dark. With these wallwashers at their current placement, any artwork that may be hung on the wall will have excellent illumination.

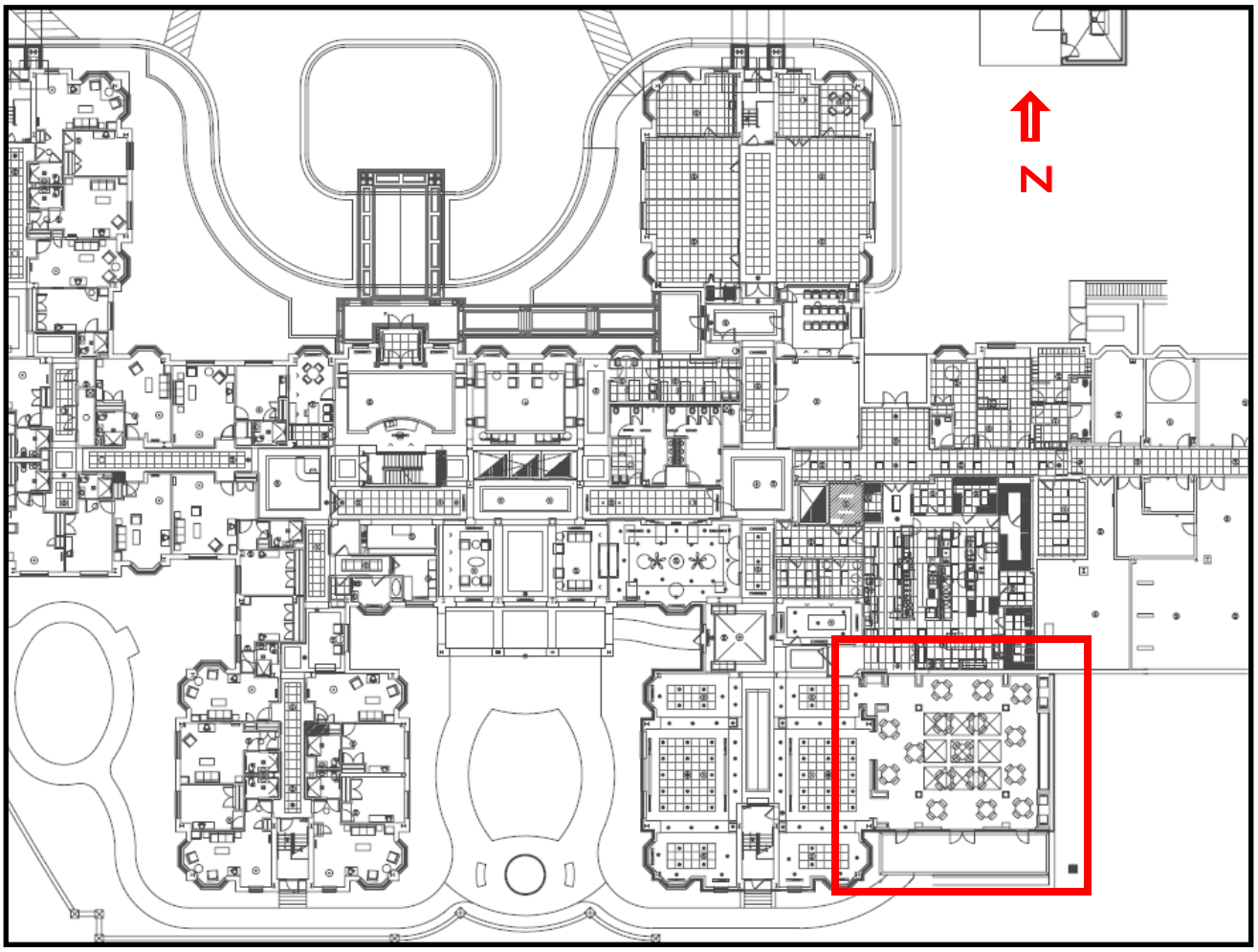
CONCLUSION

After running the various calculations for the space, I found that I met the desired design criteria of maintaining an average horizontal illuminance level of 40 fc. Now, an average is just that, an average, it really does not paint a clear picture of what is happening at a specific location in the room. When the ISO-LINE figures are referred to, one can see that at the location where the residents may need more light for reading or other tasks, i.e. where the furniture is placed, the illuminance levels are well above 40fc. With the use of cove lighting I provide indirect illumination that will limit glare and harsh contrast ratios. All electric light installations have lamp temperatures of 3000K, with CRI's of 80 or higher. With the use of low-e glazing on the doors, I limit the amount of daylight entering the space, thus reducing the luminance ratio issues that could result in discomfort glare for the residents. In addition to the low transmittance of the glazing, the covered porch reduces the direct component of the sunlight. Any light coming through the glass will be reflected light, that has already been converted into a lambertian distribution because of the diffuse surface of which it has been reflected from.

All luminaire cutsheets are provided in Appendix A and referenced by their letter/number designation. Refer to the Lighting Fixture schedule to find lamp specifications and ballast specifications. All lamps will be provided by Sylvania while ballasts are provided by Lutron and Advance Transformer. The lamp and ballast information can be found on the CD provided, of which will include the complete Sylvania lamp catalog for any reference to a specific lamp that may be desired.

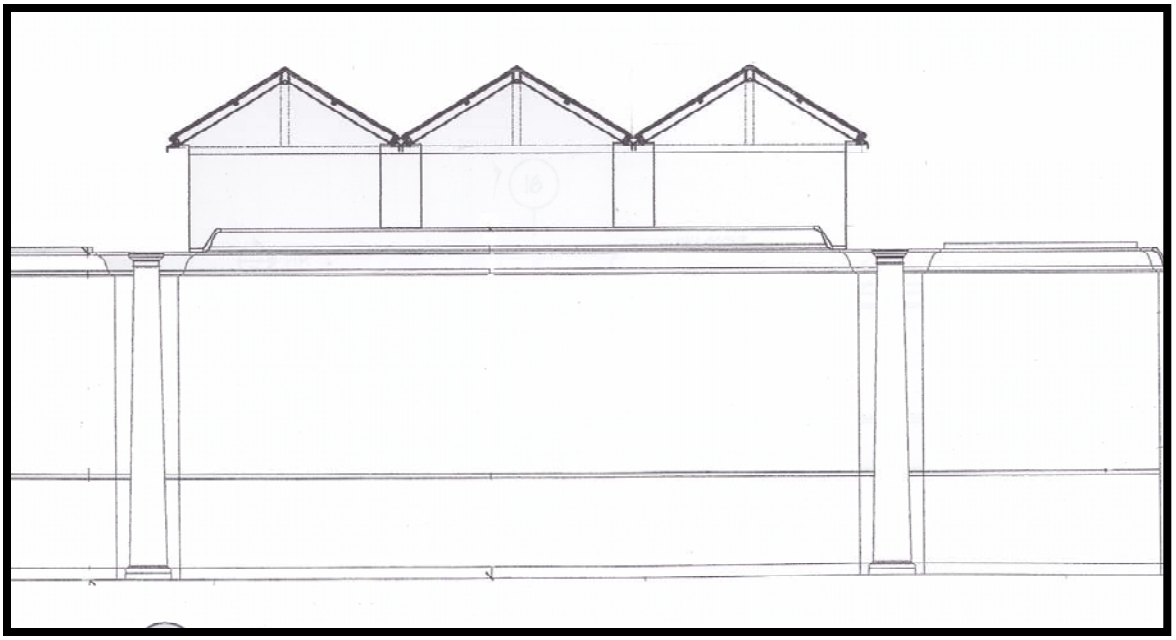
…The next space to be considered will be the **Dining Room.**

SPACE DETAILS



As it was mentioned previously, the Assisted Living Facility will be adding onto its existing structure. This addition will add approximately 56 residential suites. To handle the additional people, a dining room addition was added to the existing facility, adjacent to the current dining room. A few things to consider when thinking about this dining room space: Given the fact that this is an addition, the area adjacent to the existing dining room had to be excavating to make room for the new addition. To decrease the cost of the project, as well as to allow the surrounding areas of the facility to remain the same, the land area excavated was limited to the approximate footprint of the dining room addition. As you can see from the floor plan, a retaining wall had to be added at the east and south ends, this reduces the amount of window space available to the dining room. As a result, the Architects opted for a series of pyramid shaped skylights to make up for the lost day light. The day lit nature of the space was considered when developing the design criteria and in the schematic and final design phases of lighting program.

Sections and Elevations



In this figure one can see the way in which the skylight will be constructed. The ceiling height is 10 feet; the grid beams that support the skylights provide a well height of 2.5 feet plus the height of the skylights themselves, which is another 2 feet.

This figure shows the elevation of exterior entrance that is located on south side of the new dining room. This entrance has an 11 foot wide covered porch which helps to block direct sunlight entering through the door glazing.

Space Specific Design Criteria

Target Illuminance Levels

Horizontal – 50 fc
Vertical - 30 fc

Appearance of Space and Luminaires

With the use of the skylights, this dining room space is already segregated from the adjacent dining room by the virtue of having large amounts of daylight present throughout most of the day. With that in mind, the appearance of the space will integrate the daylight in such a way that it has more of a café type feel that one might associate with a place they would go for lunch or an early dinner. There will be a balance between this café type feel and that of a formal dining room space. With the use of warm wall colors and decorative art work, the space will maintain its formalness, while the daylight will provide higher illuminance levels to make the space feel more open. The luminaires used in the space will be integrated into the architecture wherever possible. All downlights will be outfitted with darklight reflectors that will minimize their potential to cause unwanted glare.

Color Appearance (and color contrast)

Color appearance will be achieved with the use of high CRI lamps so that as much of the visible spectrum will be present as possible. In addition to specifying lamps with high CRI values, I am going to spec two different lamp temperatures. It is recommended that for any given space, the color temperature ranges should not exceed 100K. But, given the nature of this space, I am going to argue for my design in that I will use 4100K to create a cooler daylight affect for the skylight wells. Other lamps around the perimeter space will make use of lamp temperatures of 3500K.

Daylight Integration and Control

The skylights provide the greatest opportunity to bring natural daylight into the space. The covered entrance on the south end of the dining room will also contribute daylight, but its contribution will be minimal given the size of the overhang and the retaining wall that is a few feet beyond the termination of the overhang. Any light that is present through the exterior entrance doors will be of the reflected variety and lambertian in its nature given the diffuse surfaces that it will be reflected from. Daylight control will be achieved via a photo sensor that will be located in the skylight well.

Direct Glare/Reflected

It will be important to avoid direct glare so that different luminance ratios do not make the residents uncomfortable and potentially disoriented. Both the placement and type of luminaires used will address this concern and be of the variety that results in low levels of direct glare. Reflected Glare will be avoided by the use of matte finishes and furniture.

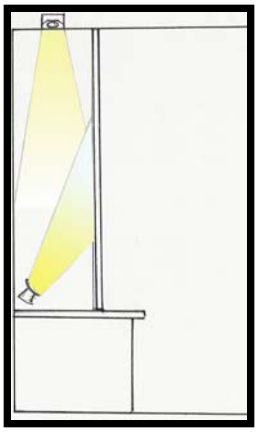
Power Allowance

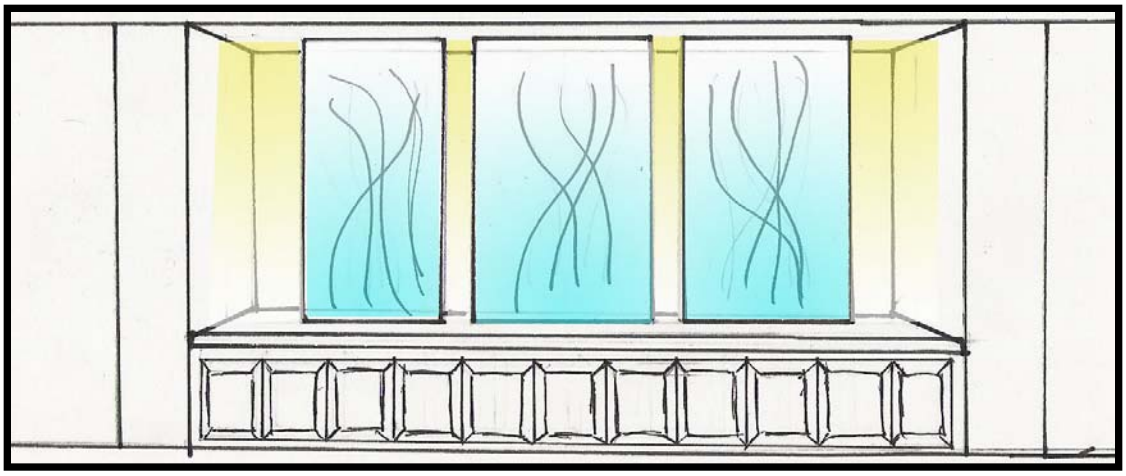
ASHRAE/IESNA 90.1 – 2.1 watts/ft^2
Based on space by space method

With the listed design criteria, I could begin to develop a schematic design that would eventually be modeled in AGI.32 from which I could calculate the necessary illuminance values.

Schematic Design of the Space

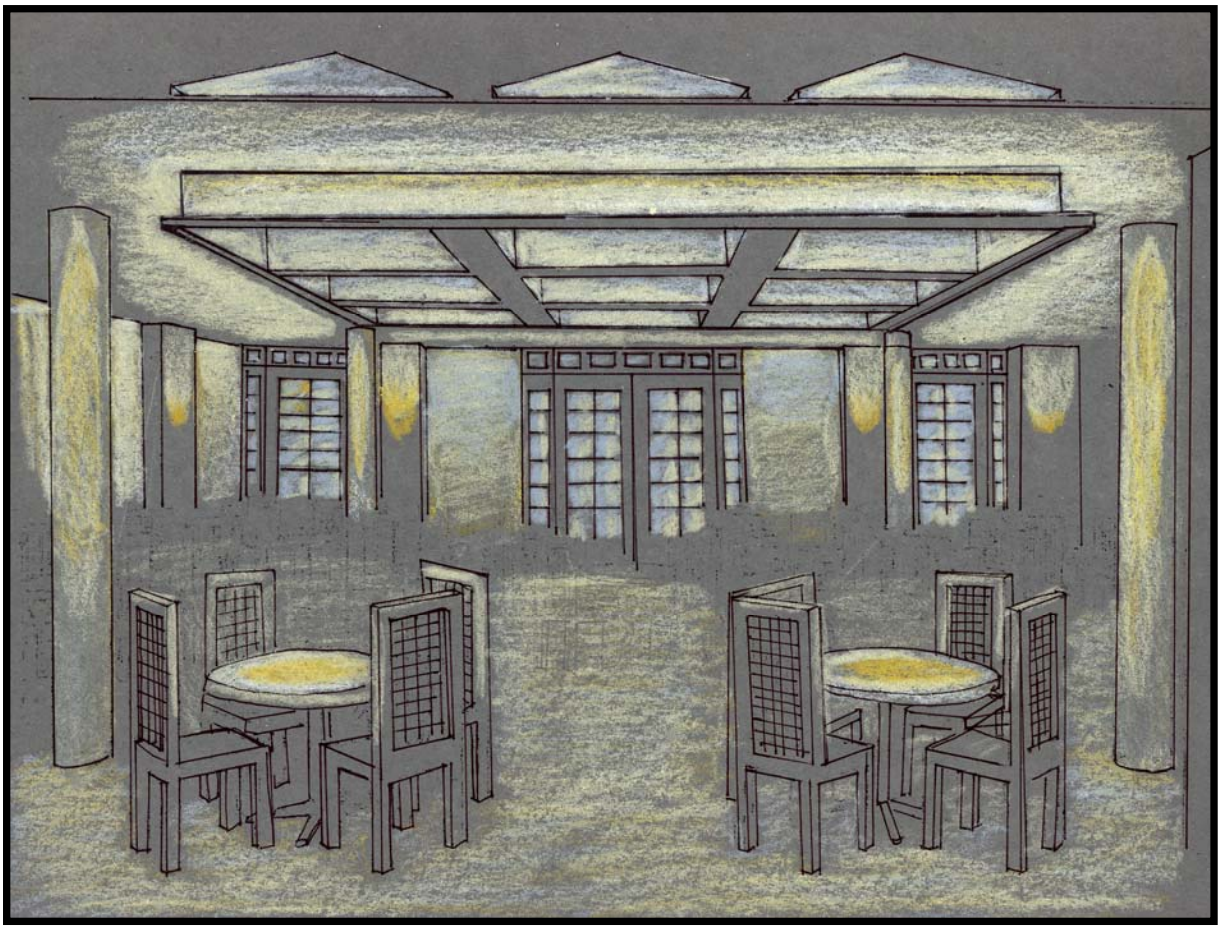
The schematic design phase of the project resulted in a brainstorming session where I decided how I wanted the light to integrated into the space. My initial schematic design tried to implement a cove lighting system to balance the luminance ratios between the ceiling and the skylight wells. After getting into the design process and running the calculations, this was a very inefficient way to provide general electric lighting. Another thought that I had during the schematic design phase was to provide a 3 panels of glass that would be back lit by color changing LEDs. After being critiqued by several lighting designers during the Lutron Presentation in December of 2005, I opted against this design as well. But, I have included some of the sketches that I produced with original design concepts because I feel that it gives strength to the design development process that took place by showing that not everything you originally want to do or implement is a good idea or efficient enough for real world installation.





Lighting depth

The previous sketches are to illustrate the glass panel design concept and how I was going to back light them. The issue with this idea is that the linear source that I show as providing general back light could have the potential to wash out the color changing LEDs. Without taking the time to mock up this installation, or the ability to accurately model it in AGI.32, I decided to remove this idea from the final design.



This is a sketch that I developed in the schematic design process. My intentions for the space were to illuminate the ceiling to balance the luminance ratios between the skylight wells and the ceiling. In addition, I wanted to wash the walls with light to again provide low contrast ratios but as well as to highlight any artwork that might be present. Downlights over the tables would provide the footcandle levels needed for the given space, while adding some sparkle to the tableware, and enhance facial modeling. If I were to use totally diffuse indirect sources, the space would be very bland and boring. By adding the downlight component, I increase the contrast ratios, but not so much so that there are visibility issues for the residents using the dining room space.

Lighting depth

Now with an overall design idea in mind, I could begin to model the space in AGI.32. The AGI.32 model was useful in analyzing the daylight contribution that the skylights made to the space. There were 5 different scenarios that I needed to study to establish how I would control the daylight entering the spaces. These scenarios include:

- March 21 – clear sky condition
- June 21 – clear sky condition
- December 21 – clear sky condition
- Overcast sky – it did not matter what time of year I looked at this condition because an overcast sky is uniform at all times of the year
- Electric light only

The surface materials of the space include:

▪ vinyl wall covering	reflectance = 50%
▪ Painted Plaster Ceiling	reflectance = 80%
▪ Carpet flooring	reflectance = 20%
▪ doors-painted	reflectance = 80%
▪ windows	reflectance = 10%(night) transmittance = 55%

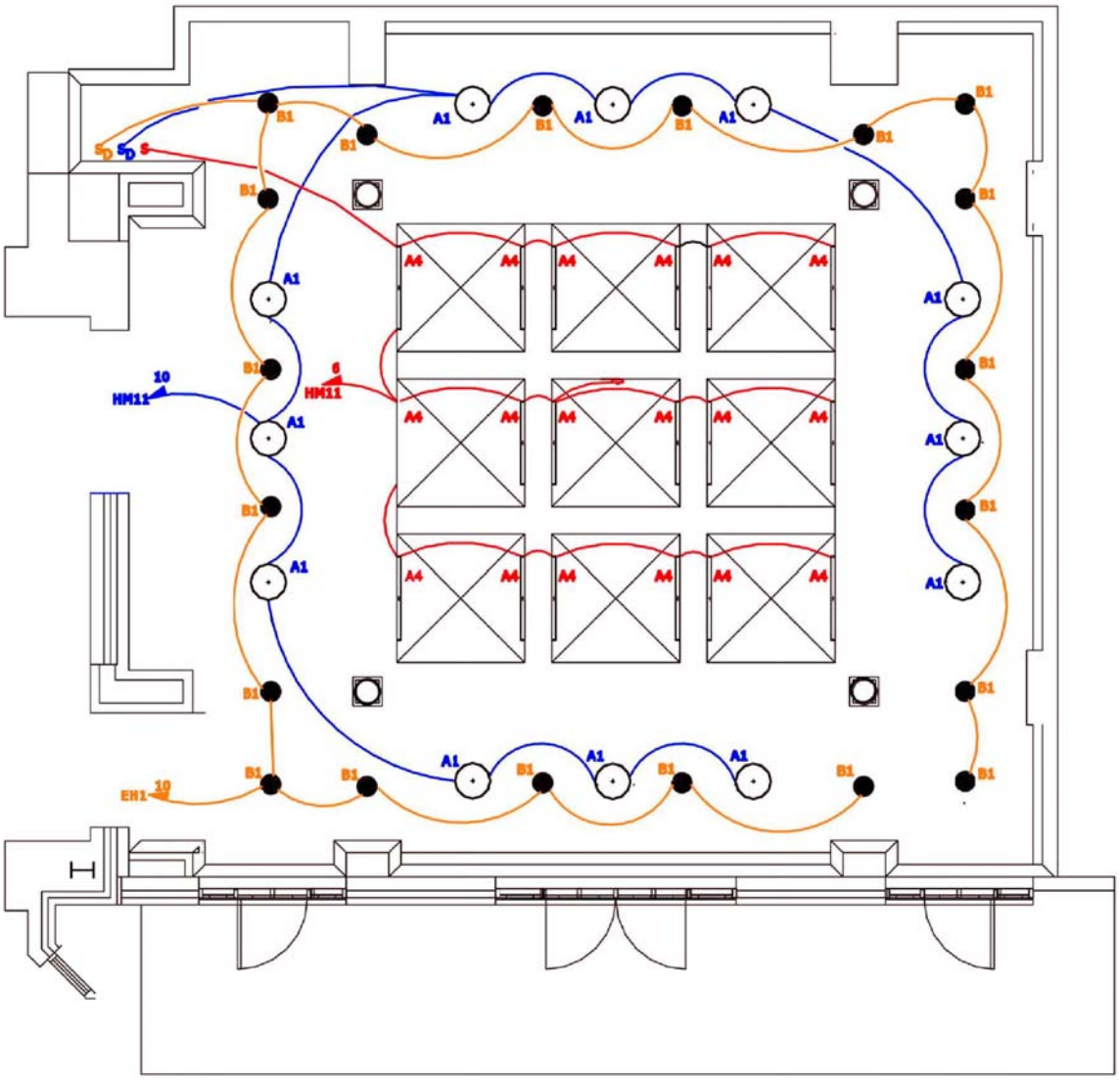
The furnishings of the space include:

▪ Wooden tables	reflectance = 10%, low specularity
▪ Wooden Chairs	reflectance = 10%

A calculation plane was added at 2.5 feet to see the various illumination values during different calculation scenarios. In the following section the electric lighting layout is presented. The different output for the various scenarios was used in determining the electric light control for the space during daylight hours.

Lighting depth

Lighting Layout



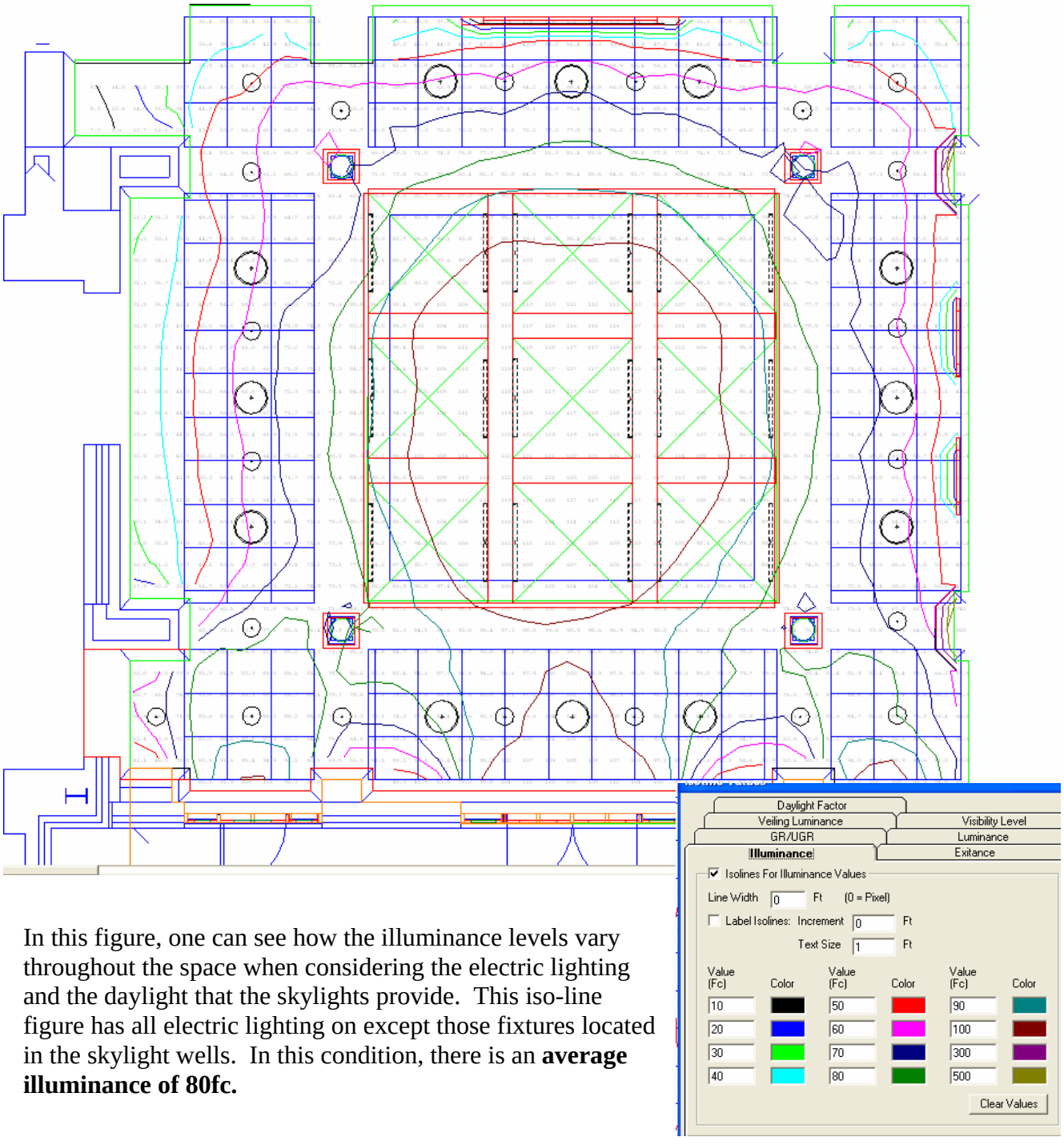
A1 – American Glass

A4 – ERCO

B1 – ERCO

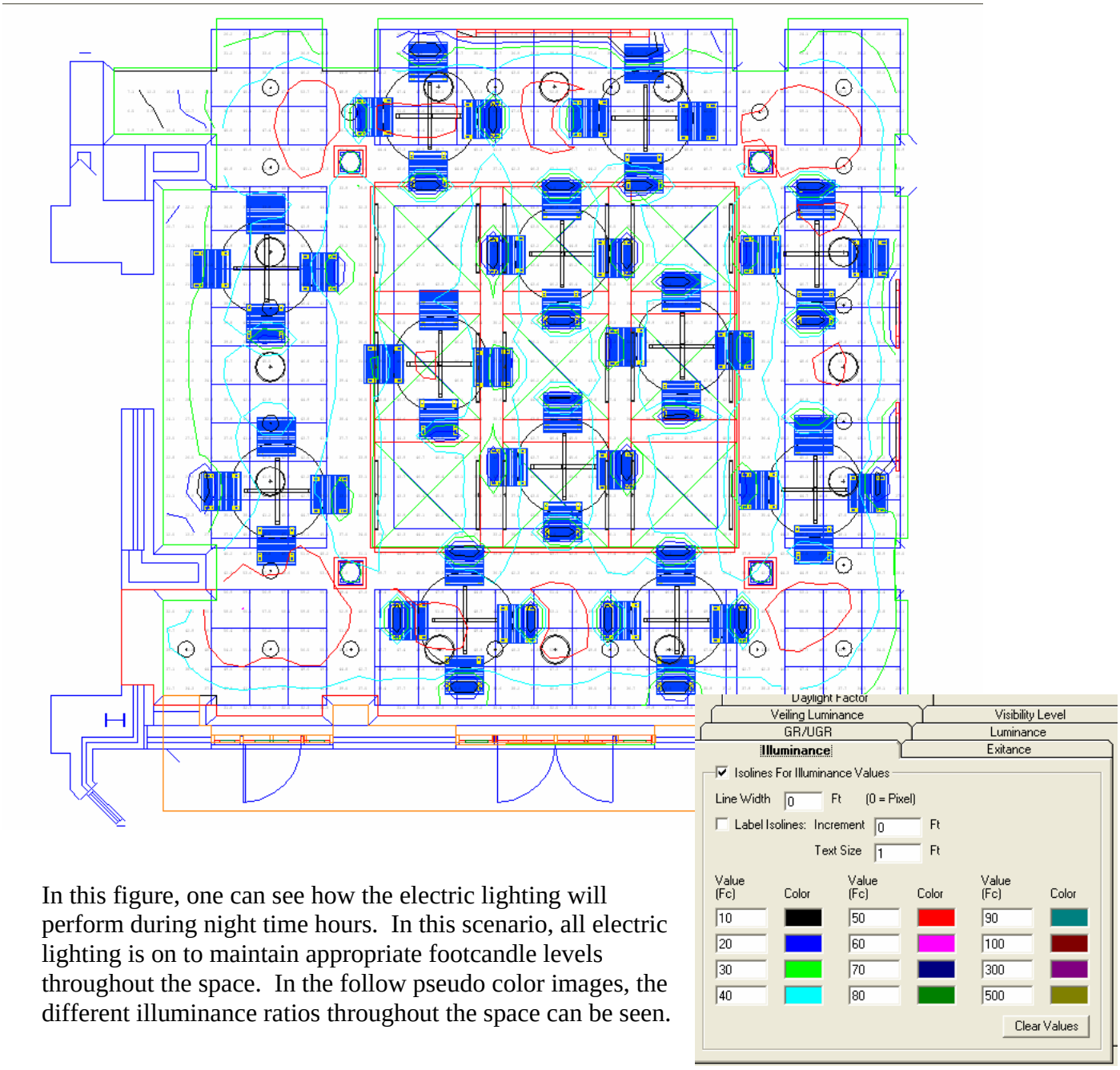
Lighting depth

ISO-LINES – Overcast Sky



In this figure, one can see how the illuminance levels vary throughout the space when considering the electric lighting and the daylight that the skylights provide. This iso-line figure has all electric lighting on except those fixtures located in the skylight wells. In this condition, there is an **average illuminance of 80fc.**

ISO-LINES – Electric Lighting Only



In this figure, one can see how the electric lighting will perform during night time hours. In this scenario, all electric lighting is on to maintain appropriate footcandle levels throughout the space. In the follow pseudo color images, the different illuminance ratios throughout the space can be seen.

PSEUDO COLOR

Lighting depth

Power Density

DINING ROOM				
Luminaire	#	ballast watts	total watts	
A1	16	42.32	677.12	
A4	18	30	540	
B1	16	58.17	930.72	
			2147.84	watt total
			1600	sq footage
			1.3424	w/sqft

ASHRAE 90.1 – Using the space-by-space method

2.1 W/ft^2

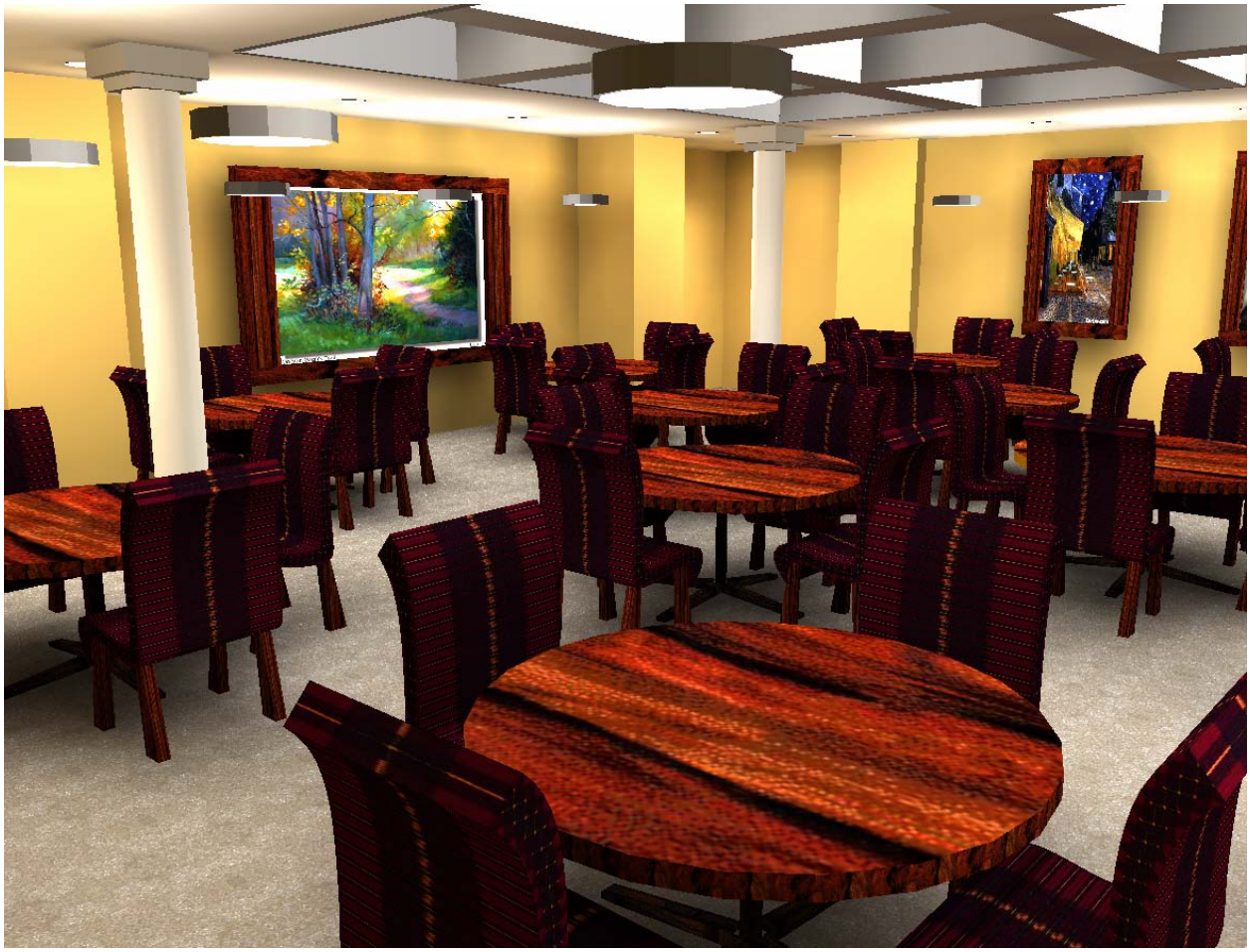
Branch Circuit Connecting Load

SPACE	PANEL	V	CKT #	CONNECTED VA	CON'T LOAD(1.25)	Max amps/ckt
Dining Rm	HM11	277	6	540	675	<4438
Dining Rm	HM11	277	10	677.12	846.4	<4439
Dining Rm	EH1	277	10	930.72	1163.4	<4440

Light Loss Factors

DINING ROOM									
LIGHT LOSS FACTORS									
TYPE	BF	CLEANING INTERVAL	MAINTENANCE CATEGORY	LLD	RSSD	LDD	TOTAL	ROOM CAVITY RATIO	
A1	1	CLEAN (12MONTHS)	II	0.86	0.93	0.95	0.75981	h	10
A4	1	CLEAN (12MONTHS)	III	0.93	0.95	0.9	0.79515	L	40
B1	1	CLEAN (12MONTHS)	V	0.91	0.97	0.88	0.776776	W	40
								RCR	2.5

RENDERINGS



This rendering gives some idea of what the space may look like given the electric lighting layout. The skylight wells are illuminated with surface mounted wallwashers, which are mounted at a height of 12 feet and fit nicely in the skylight wells. There were several things that I could have done when approaching the skylight wells during night time conditions. There was an idea to not provide any source of electric lighting in this area, but, during the night time hours, the other luminaires did not provide adequate illuminance levels. I also thought about uplighting these wells, but then there would be an issue with the darksky compliance. The skylight wells are a structural member in and of themselves, so there was not a way to recess a luminaire in the well to make a more integrated solution. The surface mounted wallwasher from ERCO were my best solution to this area. The slim profile and white finish make it less noticeable. I do not believe there will be issues with glare given that fixture is mounted in the well itself and at most visual

angles, the luminaire will not be visible. The tables around the perimeter of the space are illuminated by indirect pendants that have (1)42W-triple tube compact fluorescent lamp, and recessed downlights that have (2) 26W compact fluorescent lamps. The mixture of indirect and direct lighting helps to soften the contrast ratios and provide nice levels of illumination on the table surface. The indirect pendants are also helpful during the day to balance the luminance ratios between the ceiling and the skylight wells.

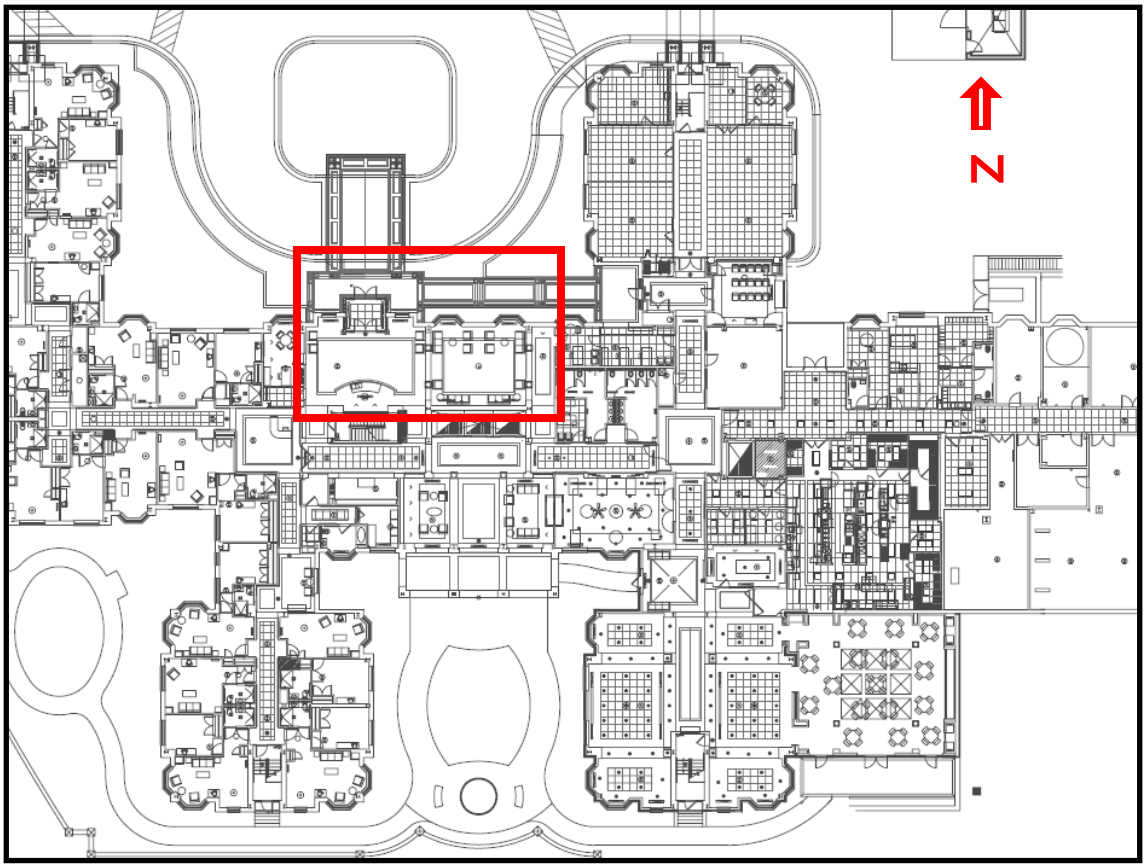
CONCLUSION

After running various calculations for the space, I found that I met the desired design criteria of a horizontal illuminance level of 50 fc with the electric lighting. During the day, these illuminance levels will be much higher due to the skylights in the space. The skylights are great for an Assisted Living Facility setting. Given the changes that can occur in the circadian system as one ages, sleeping disorders can develop, of which can affect mood and health. By providing an area that is brightly illuminated during the daylight hours, residents have the opportunity to correct their internal body clock and hopefully avoid some of the associated health problems associated with sleeping disorders. There is also a reduction in the electric lighting used in the space during daylight hours. The surface mounted wallwashers are connected to photo sensor that is mounted on a skylight well wall. When that sensor sees and illuminance level of 100 fc or more, it turns the associated electric lighting off, thereby saving energy. As it was mentioned earlier, all electric light installations have lamp temperatures of 3500K with the exception to those luminaires mounted in the skylight wells, which have lamp temperatures of 4100K to maintain a cooler daylight appearance when they are in operation. Dimming of either the pendants or downlights can be done at the wall switches. The space falls within ASHRAE 90.1 power density requirements of having less that $2.1W/ft^2$

All luminaire cutsheets are provided in Appendix A and referenced by their letter/number designation. Refer to the Lighting Fixture schedule to find lamp specifications and ballast specifications. All lamps will be provided by Sylvania while ballasts are provided by Lutron and Advance Transformer. The lamp and ballast information can be found on the CD provided, of which will include the complete Sylvania lamp catalog for any reference to a specific lamp that may be desired.

…The next space to be considered will be the **Lobby**.

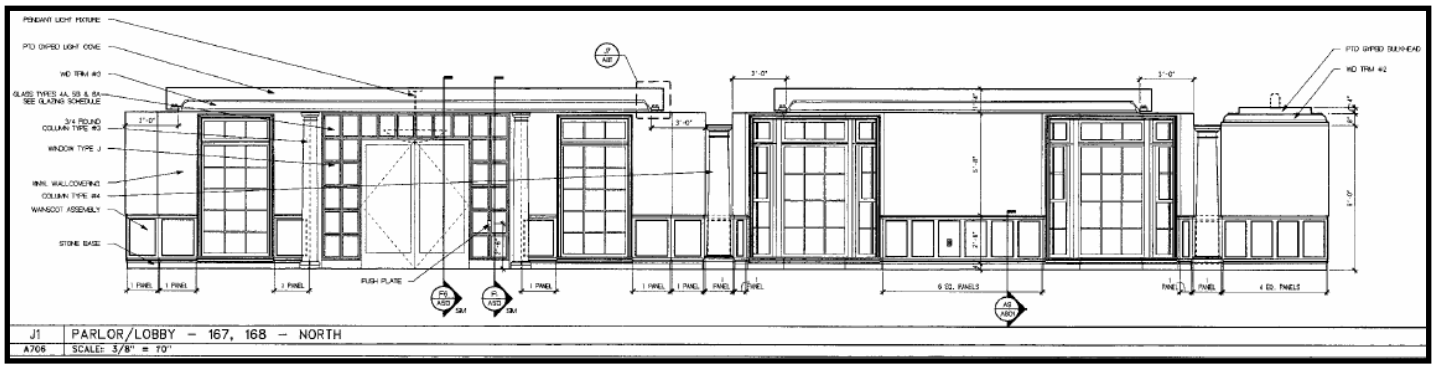
Space Details



The lobby serves as the main entrance point into the facility for residents and visitors alike. The northeastern windows are shielded by the roof that covers the walkway. Given the northern orientation and covered walkways, there should not be any issue with direct daylight. This space is somewhat challenging given the fact that it is a transition point from indoors to outdoors. As we age, our pupils become smaller and have a decreased ability to change when confronted with the drastic illuminance changes encountered when moving from indoors to outdoors, and vica versa. Therefore, when developing the design criteria and eventually the light design for the space, special consideration was taken for this space.

Lighting depth

This figure shows northern elevations of the lobby space. Please disregard any luminaires that are shown in these figures as these are of the previous lighting design and not of my own. In this figure one can see the large expanse of glass along the northern wall. This will aid in bringing daylight into the space, and because it is north facing, it will be relatively consistent throughout the day, with few if any problems of direct sunlight penetration.



Space Specific Design Criteria

Target Illuminance Levels

Horizontal :	100	fc – interior entry (day)
	10	fc – interior entry (night)
	30	fc – visitor waiting-parlor (day)
	10	fc – visitor waiting-parlor (night)
Vertical :	10	fc – interior entry/visitor waiting (day)
	3	fc – interior entry/visitor waiting (night)

Appearance of Space and Luminaires

This is the first space that is encountered when entering the space, so the décor and feel of the space should set a standard by which the rest of the facility upholds. The assisted living facility is for long-term residents, and the warmth and comforts of home should be felt within the space. The appearance should be formal and inviting. The luminaries should be integrated into the architecture of the space, and those visible should be tasteful and elegant.

Color Appearance (and color contrast)

The lobby itself is dressed in European inspired seating, carpeting and furniture. The rich and vibrant colors need to be accentuated and brought to life with the use of correct lighting sources. Lamps with high CRI values will be used and architectural highlighting will be done wherever possible.

Daylight Integration and Control

The windows and doors of the lobby face the northern direction. Direct sunlight that could cause unwanted glare and high luminance ratios should not be a problem. In addition to facing north, the windows on the northeastern side are shielding by the roof that covers the walkway. Daylight will be studied and integrated into the space. The possible use of photo sensors and daylight dimming controls will be investigated. The integration of daylight will also help balance the transition from inside to outside light levels, so that adaptation time will be shorter.

Direct/Reflected Glare

Direct glare from daylight should not be an issue. Other potential glare sources are the luminaries themselves. Luminaires with smaller apertures will be used, as well as baffled lenses if it seems necessary. Ceiling luminance ratio will be balanced so that the luminaries and the ceiling beside the luminaires do not exceed a ration of 100:1. The receptionist sits in the lobby area and veiling reflections as well as reflected glare will need to be avoided due to the use of a computer.

Power Allowance

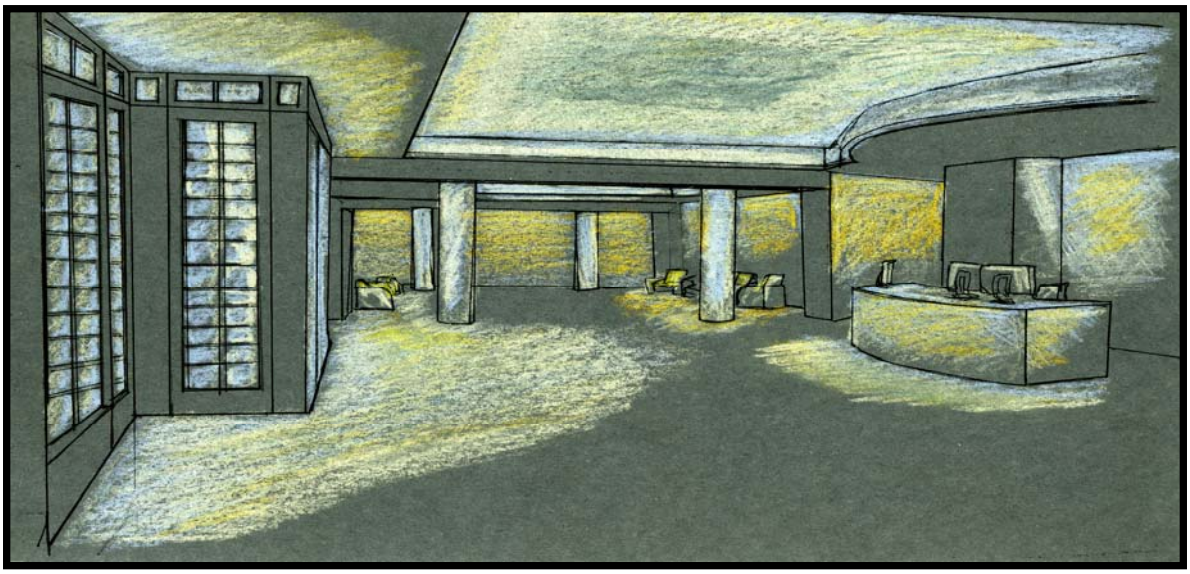
ASHRAE/IESNA 90.1 -	1.3 watts/ft^2
Based on space by space method	1.0 watts/ft^2 – for decorative chandelier-type luminaries or sconces or for highlighting art or exhibits

With the listed design criteria, I could begin to develop a schematic design that would eventually be modeled in AGI.32 from which I could calculate the necessary illuminance values.

Schematic Design of the Space

In the schematic design process, I tried to develop a lighting program that would be implemented in a final design. My initial thoughts were to utilize a cove that would be used to provide indirect general illumination throughout the space. Then, with the use of downlights, I would further increase the illuminance levels to the desired values. The following schematic shows my initial design concept.

Lighting depth



In this sketch, I am showing the ceiling illuminated with the use of a cove lighting system. The windows and entry way doors give an opportunity for diffuse daylight to make its way into the space. The walls are washed with light to make the space feel more open. The receptionist area is highlighted to provide a visual cue to where one could find assistance. After developing the design concept, I could see how my idea would perform in AGI.32 and if this would be a realistic design solution for the space. The reflectance of the ceiling, walls, floor, and the like are provided below. These values went into the 3-dimensional model that was used to produce the desired lighting calculations.

The surfaces of the space include:

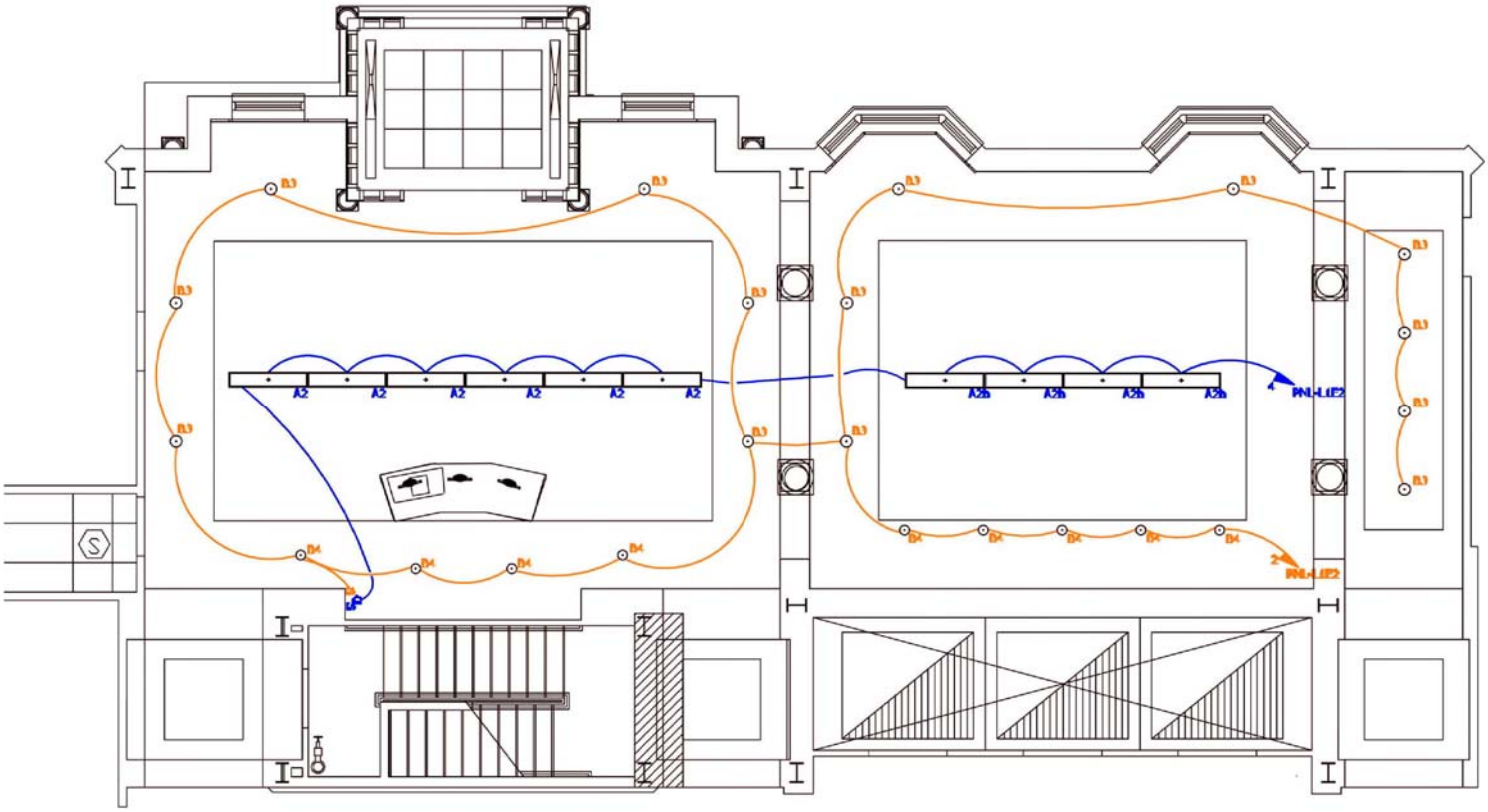
- vinyl wall covering — reflectance = 50%
- ceiling – painted gyp board — reflectance = 70%
- marble tile and carpet flooring — reflectance = 20%
- wainscot – wood stain — reflectance = 30%
- doors – painted — reflectance = 60%
- windows — reflectance = 10% (night)
  transmittance = 60%

The furnishings of the space include:

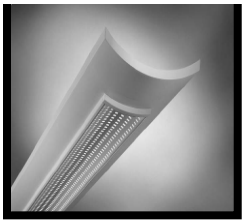
- European inspired chairs and benches — reflectance = 20%
- Reception desk – wood — reflectance = 30%
- Wooden tables — reflectance = 20%

Lighting depth

Lighting Layout

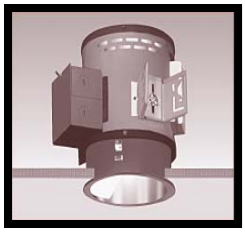


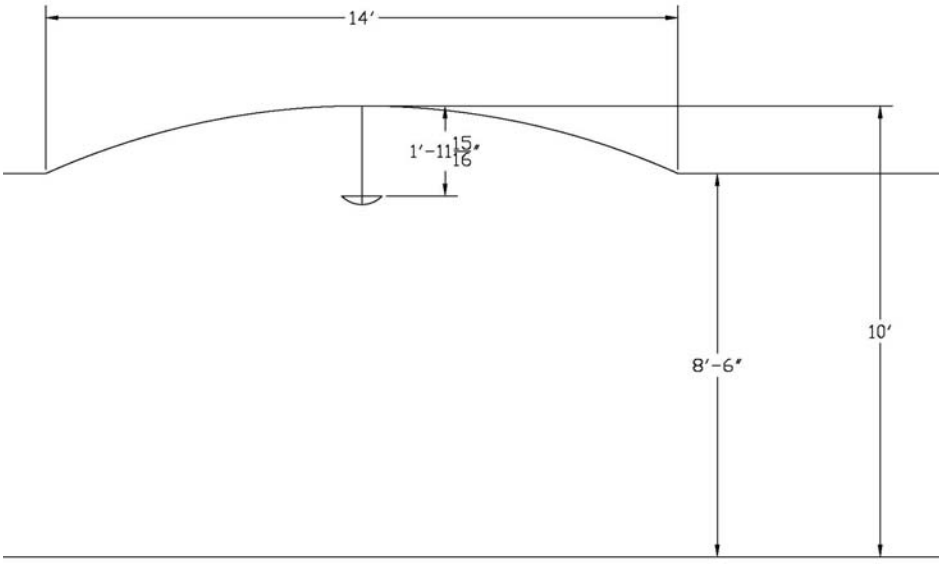
A2 & A2b – Focal Point



B3 – ERCO

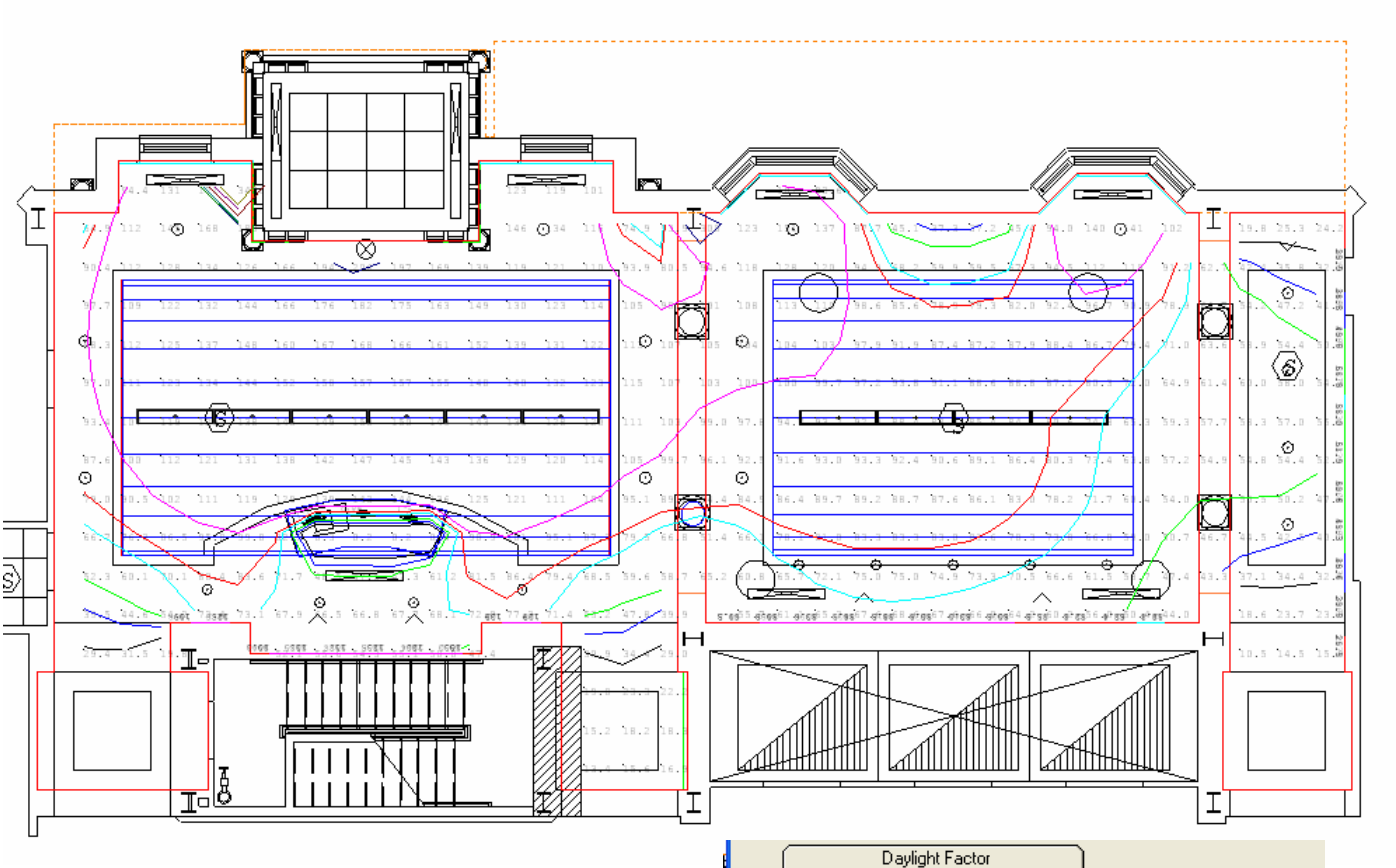
B4 – Focal Point

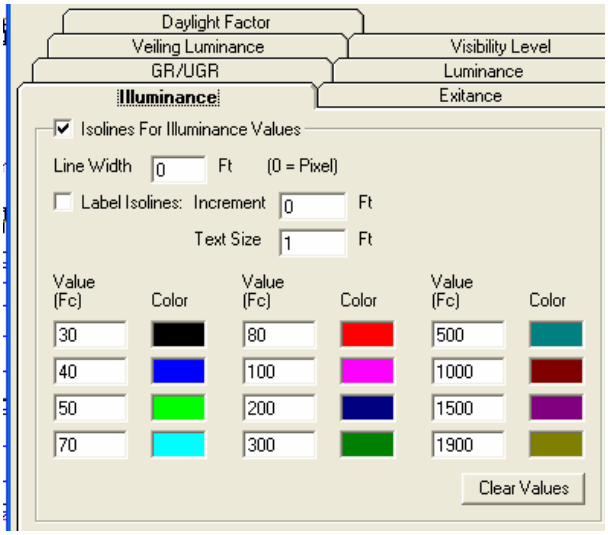




Barrel Vault Detail

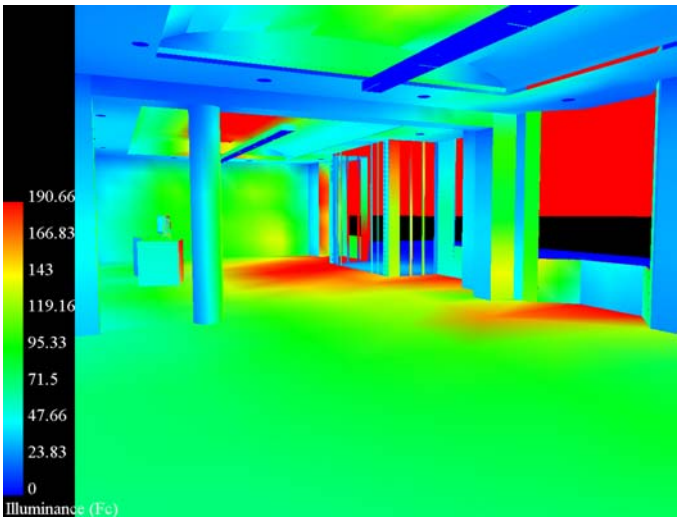
Lighting depth

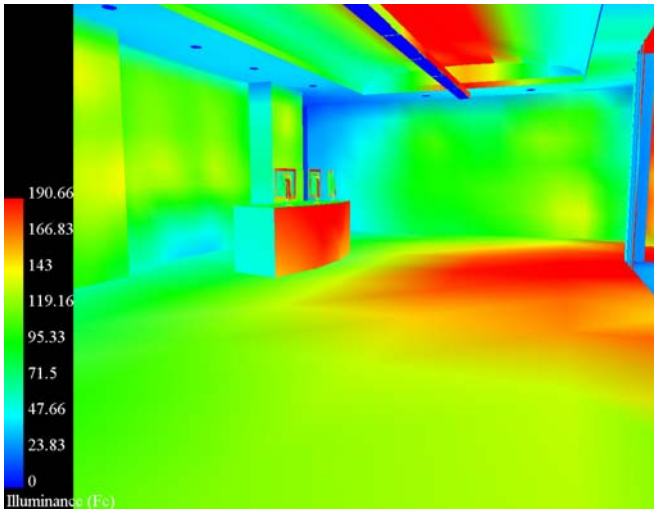


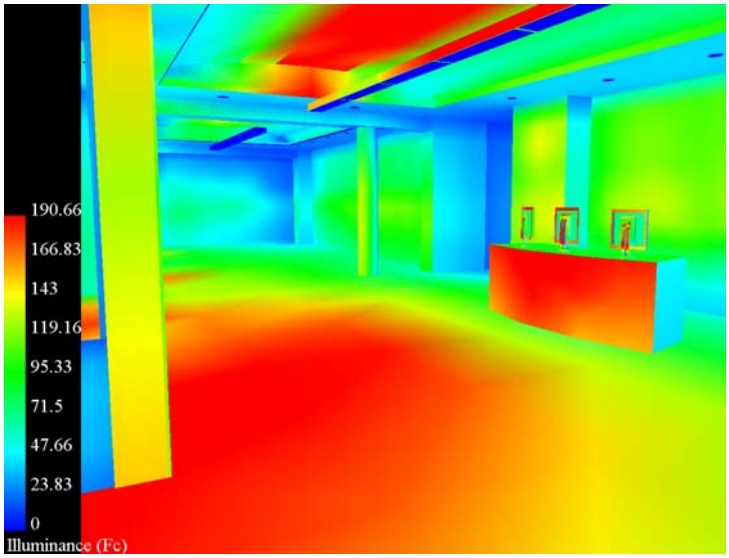


The ISO-LINE diagrams give a nice way of representing where the light is falling within a given area of the space. This ISO-LINE diagram, as well as pseudo color and renderings to follow, consider the electric lighting and daylight. The daylight condition is a clear day on June 21 at 12 noon. I used this day as being the worst case scenario for the lobby acting as a transition space from indoor to outdoor illuminance levels. This time of year is when the sun would be at it highest level, and a time when there would be the greatest illuminance different between indoors and outdoors. By checking the illuminance ratios that the electric light can provide in response to the daylight, I could judge how well I felt the design I suggest implementing performs.

Lighting depth







The Pseudo Color Images show illuminance differences that occur throughout the space. I wanted to maintain an illuminance ratio that did not exceed 10:1 between any one of the surfaces. I feel that if the electric light could balance the daylight with that ratio, there would not be a significant issue with contrast sensitivity. As you can see from the linear scale, the illuminance levels are at the upper bound of the design criteria suggested target illuminance level of 100fc. I feel that the design that I suggest provides one of the best solutions in that it is able to achieve the desired illuminance levels during the day that make the transition from indoors to outdoors, and visa versa, more comfortable and safe for the older residents in the facility.

Lighting depth

Power Density

LOBBY				
Luminaire	#	ballast watts	total watts	
A2	6	124.65	747.9	
A2b	4	69.25	277	
B3	14	58.17	814.38	
B4	9	33.24	299.16	
			2138.44	watt total
			1600	sq footage
			1.336525	w/sqft

ASHRAE 90.1 – Using the space-by-space method.

1.3 W/ft^2
1.0 W/^{ft2} decorative lighting

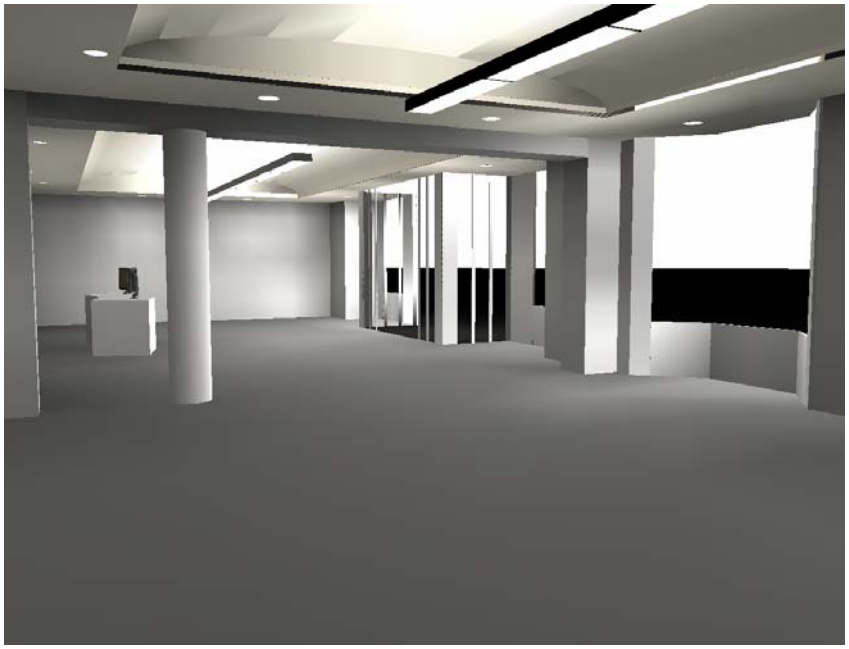
Branch Circuit Connected Load

SPACE	PANEL	V	CKT #	CONNECTED VA	CON'T LOAD(1.25)	Max amps/ckt
Lobby	L1E2	277	2	1114.38	1392.975	<4434
Lobby	L1E2	277	4	1246	1557.5	<4435

Light Loss Factors

LOBBY									
LIGHT LOSS FACTORS									
TYPE	BF	CLEANING INTERVAL	MAINTENANCE CATEGORY	LLD	RSSD	LDD	TOTAL	ROOM CAVITY RATIO	
A2	1	CLEAN (12MONTHS)	II	0.93	0.95	0.95	0.839325	h	10
A2b	1	CLEAN (12MONTHS)	II	0.93	0.95	0.95	0.839325	L	67
B3	1	CLEAN (12MONTHS)	V	0.91	0.96	0.88	0.768768	W	26
B4	1	CLEAN (12MONTHS)	III	0.91	0.92	0.9	0.75348	RCR	2.669346

RENDERINGS



The higher illuminance levels needed for better adaptation from indoor to outdoor light conditions during the day were achieved with direct/indirect linear pendants that utilize 54T5HO lamps. These luminaires have an efficiency of 95%. As you can see from the renderings, I choose to incorporate a barrel vaulted ceiling which helps to redirect the reflected light down to the floor. It could be thought of as working along the same lines as a parabolic reflector. I understand that there will be a lambertian distribution of reflected light from the ceiling, but by using the barrel vault, I do not loose light in the corners, as I would if I went with a square cove approach. The cove lighting was completely disregarded in this area. It was not nearly efficient enough; there was no way to provide the necessary illuminance levels without going over power density allowances. The linear pendants in the lobby area, which has the receptionist's desk and the entry to the building, have (2)54T5HO, while the parlor area makes use of only (1)54T5HO. The walls are washed with light and this affect is achieved by recessed-round washlights that use (1)26W-CF lamp. They help to balance the luminance ratio throughout the space and create a more open environment. Other perimeter lighting is achieved with recessed downlights that use (2)26W-CF lamps. The color temperatures of all lamps are 4100K, with CRI

values of 80 or higher. I choose a higher lamp temperature for this area given the transition from daylight to indoor electric lighting. The high lamp temperature will complement the cooler color appearance of the daylight environment.

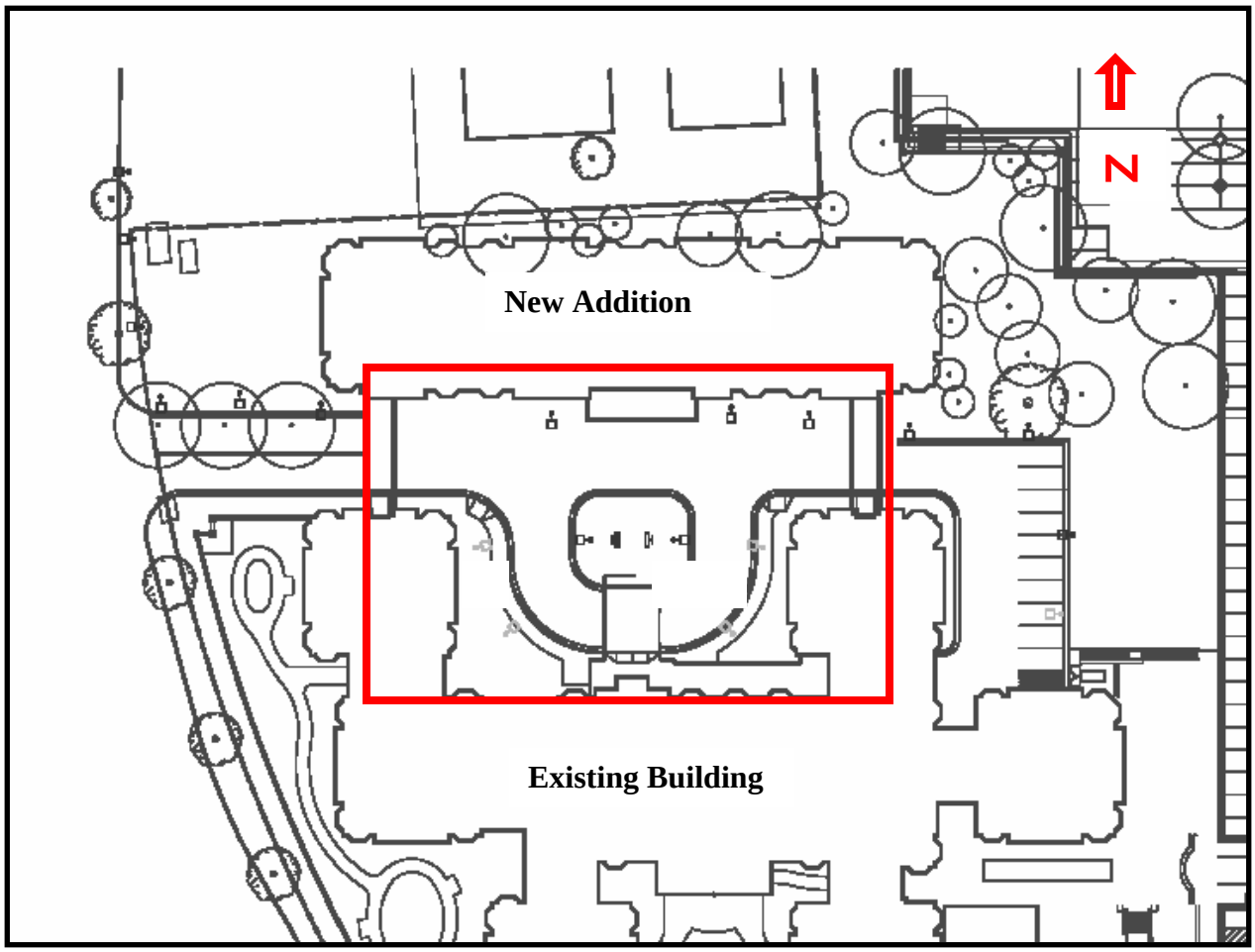
CONCLUSION

As I have already explained, the nature of this lobby space is such that the transition from outdoors to indoors need to be addressed by provided higher illuminance levels during the day and lower illuminace level during the night time hours. For daylight conditions, all electric light will be on, while at night time hours, the only luminaires that will be on are the linear pendants. They will be outfitted with dimming ballast so that the light levels can be brought down to the desired levels. The receptionist will be in control of this environment and will decide by how much the lights are dimmed during night time operation. It will also be suggest that she/he turn off perimeter lighting during the night to save energy, the linear pendants will be able to provide the desired illuminance levels by themselves. Overall, I am confident with the lighting design that I suggest. It meets the design criteria by reaching proper illuminance levels during daytime operation, and it does this while staying within the power density requirements of ASHRAE 90.1

All luminaire cutsheets are provided in Appendix A and referenced by there letter/number designation. Refer to the Lighting Fixture schedule to find lamp specifications and ballast specifications. All lamps will be provided by Sylvania while ballasts are provided by Lutron and Advance Transformer. The lamp and ballast information can be found on the CD provided, of which will include the complete Sylvania lamp catalog for any reference to a specific lamp that may desired.

…The next and final space to consider will be the **Outdoor area and Building Entrance**

Lighting depth

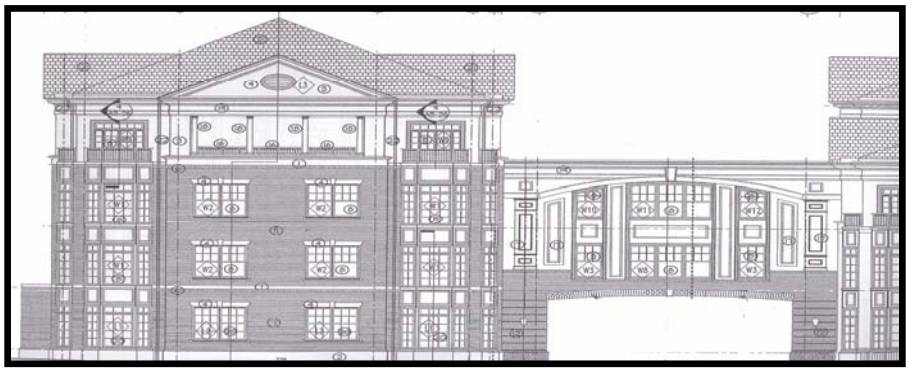


The main building entry will be considered as well as the walkways. The function of the electric lighting that is provided for this space is to address the needs of outdoor illumination during the night time hours. Given the fact that this is an Assisted Living Facility, there will be no exterior building illumination designed. The reason for this, which is apparent, is that fact that the light could shine in to the resident's rooms and be bothersome during night time hours when they are trying to sleep. As it was discussed earlier, older individuals often have sleeping disorders, so it would not be appropriate to provide a lighting design that could further affect them. In the next section, you will see pictures of the existing building. The new addition will be under construction in the summer of 2006, so no pictures are yet available of that structure. I have included the Architectural Elevation of that addition so that you can get acquainted with the space.

Lighting depth

Pictures

These pictures show the existing building entrance, as well as the brick paved walkways, and the covered walkway that is along the northern façade of the lobby space.



This is an Architectural Elevation of the new addition. Bridged walkways will connect at the northwestern and northeastern pods at the second floor levels. This new addition provides additional tenant rooms as well as a parking

garage on the first floor level. The addition is where the remainder of this thesis project focuses and can be found in the different sections following the light depth report.

Space Specific Design Criteria

Task

The main task the exterior lighting has to serve is somewhat two fold. The pole mounted lights need to provide general illumination on the roadway and walkway so that pedestrians can move about safely and have enough light to see. Given the older population of people residing in this building, the overall illumination must be higher. As it is stated in the *General Design Criteria*, higher illuminance levels are needed to distinguish contrast, depth perception, and adaptation time. With that said, the overall lighting levels need to be high as well as the entry to the building.

Illuminance Values

Horizontal : 5 fc – suggested for walkways
10 fc – exterior entrance
Vertical : 1 fc – facial recognition

Appearance of space of Luminaires

The pole lights should remain elegant and prominent as they lay against the building background. The look of the luminaire should compliment the architecture and not look industrial. The entrance to the building should be inviting, and the luminaries should be integrated within the architecture.

Color Appearance (and Color Contrast)

Lamp color temperature should be warm, somewhere around 3000K to look similar to other lighting throughout the building. When vegetation is illuminated, lamp choice will be critical so that the colors are accentuated and well represented. Contrast is important so that residents can differentiate differences in elevation.

Direct Glare and Reflected Glare

Residents' rooms will be in view of the outdoor lighting, as a result, the pole-mounted luminaries should have sharp cut off so that direct light does not spill into their rooms. The orientation and location of these luminaries will be addressed. Reflected glare should not be an issue given the low reflectance of the building materials.

Power Allowance

ASRAE 90.1 – 9.4.5 **Exterior Building Lighting Power.** The total exterior lighting power allowance for all exterior building applications is the sum of the individual lighting power densities permitted in Table 9.4.5 for these applications plus additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among exterior lighting applications listed in the Table 9.4.5 "Tradable Surfaces" section.

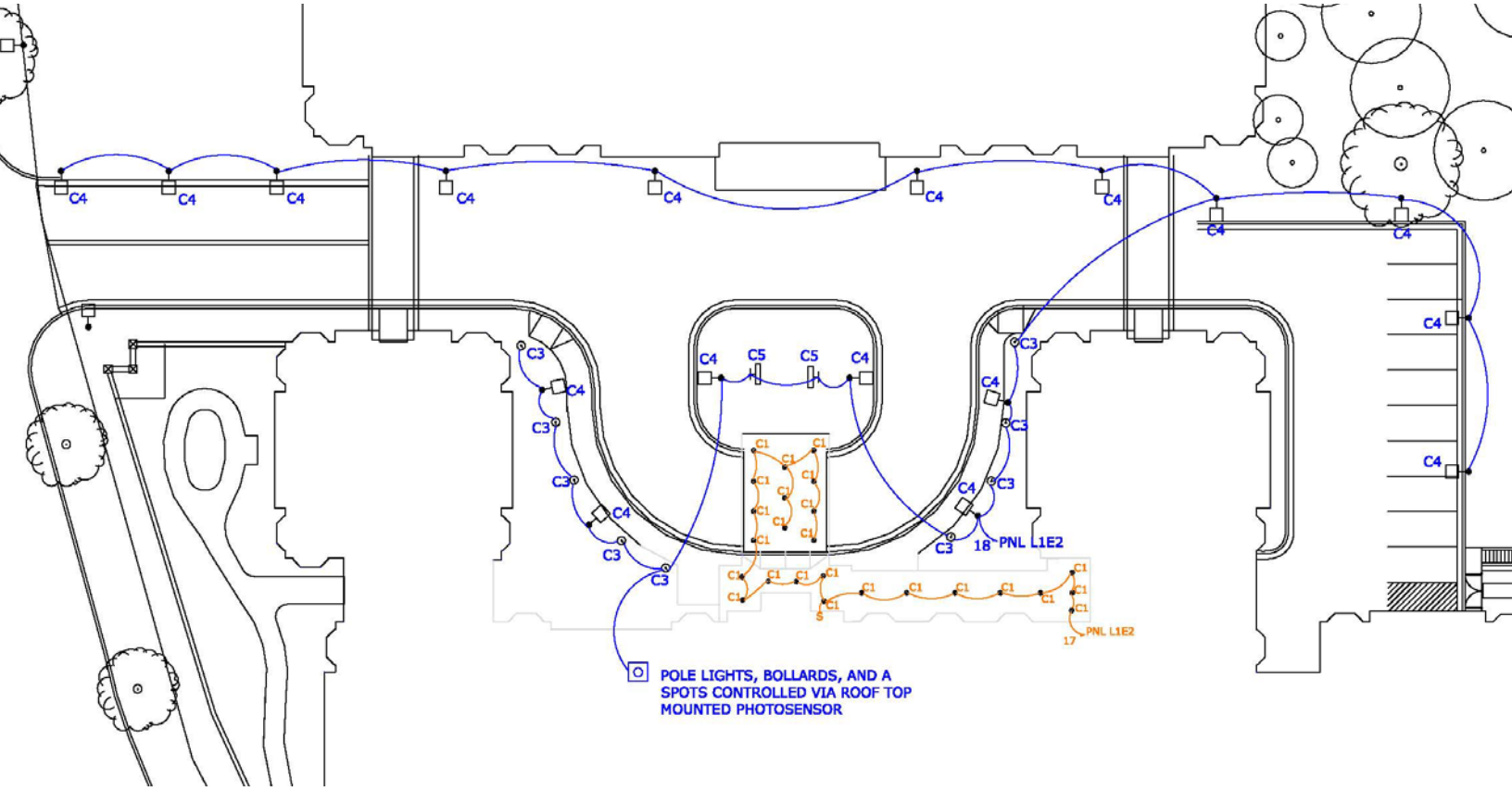
Schematic Design of the Space

The lighting design of this space is more for function than for aesthetics. As the design criteria mentions, the luminaire choices will be such that they compliment the architecture, but the over all design theme will be one of function in that it will provide the required illuminance levels. With that said, I used AGI.32 to perform calculations of the different design scenarios. 3-dimensional building models were used to see how the luminaires behaved with the surrounding building structure. The reflectance values shown below were applied when developing the calculations.

The surface materials of the space include:

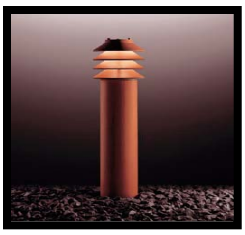
- red brick reflectance = 20%
- white wood trim reflectance = 40%
- painted stucco reflectance = 30%
- asphalt reflectance = 15%
- red brick pavers reflectance = 20%

Lighting depth



C1 - ERCO

C3 - Bysted

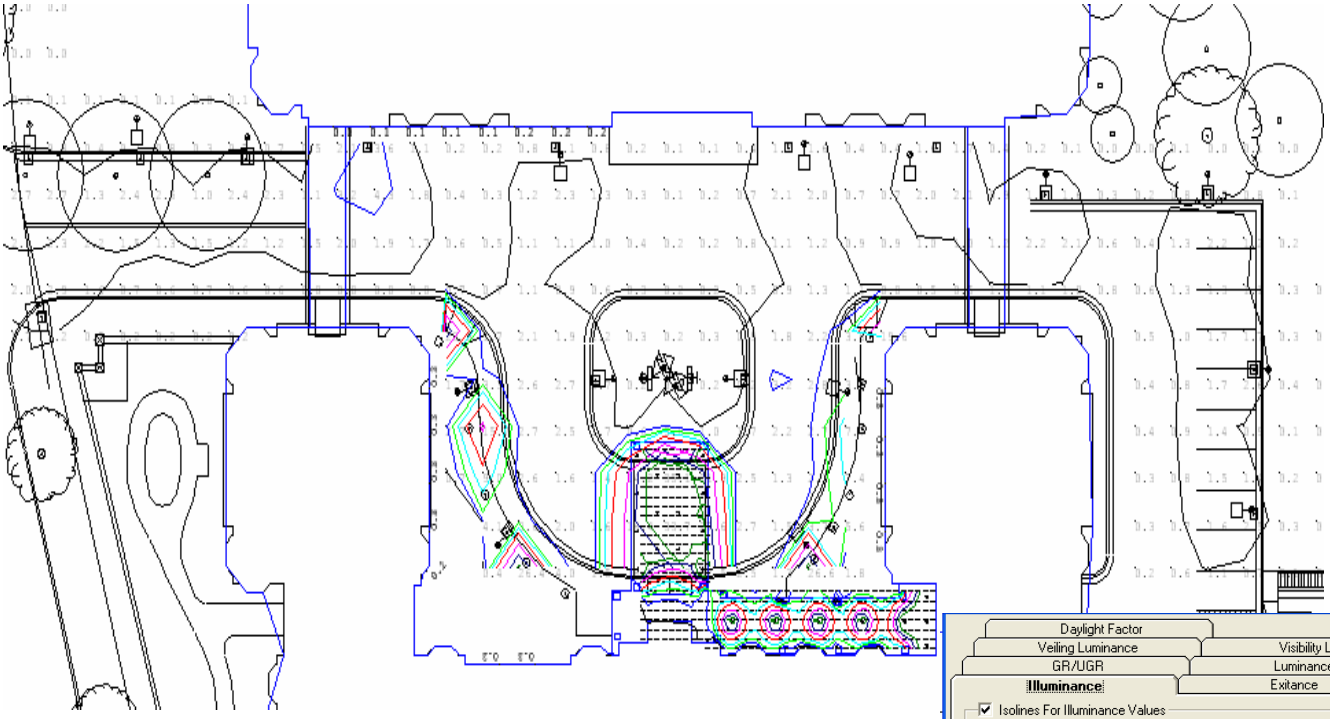


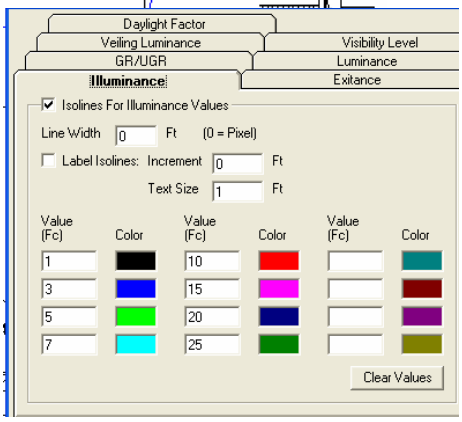
C5 - ERCO

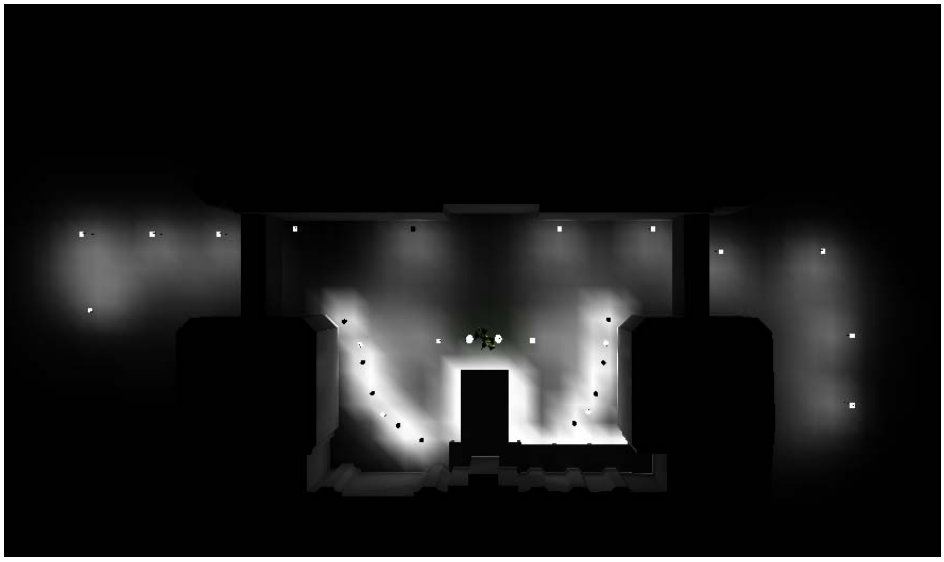
C4 - Providence

Cut-off Sheild

Lighting depth

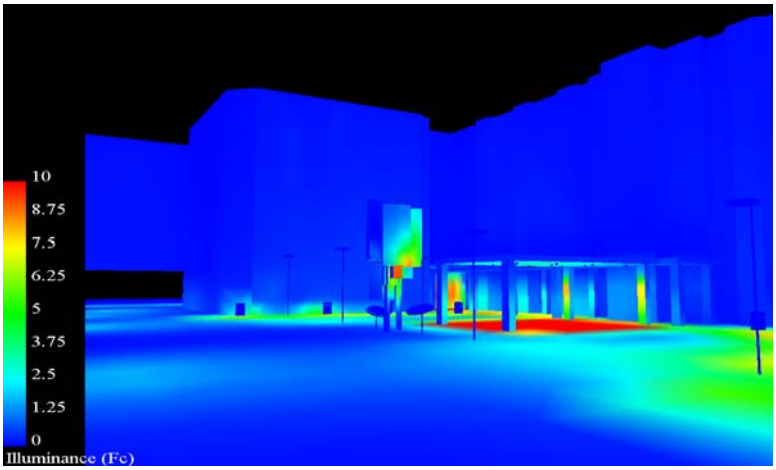


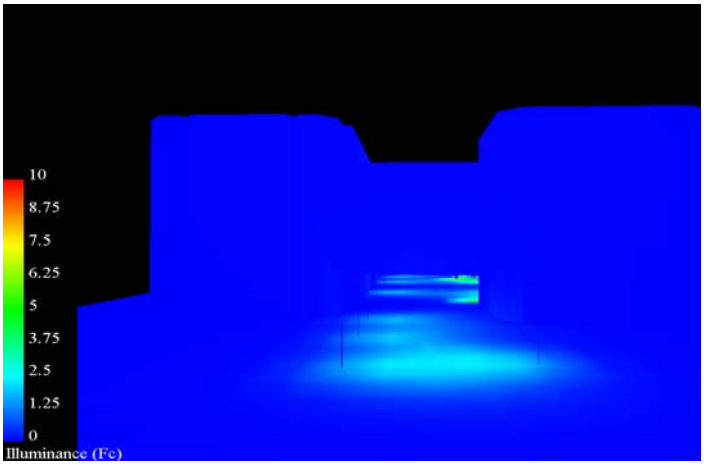


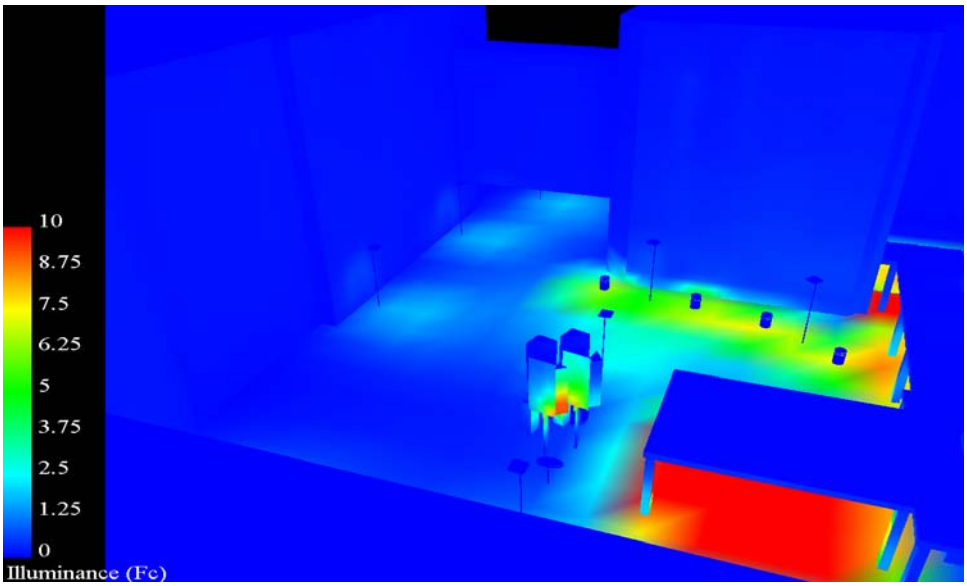


The Isolines and renderings show different illuminance levels that are achieved with the various luminaire selections. Higher illuminance levels are achieved with bollards for the brick walkways.

PSEUDO COLOR



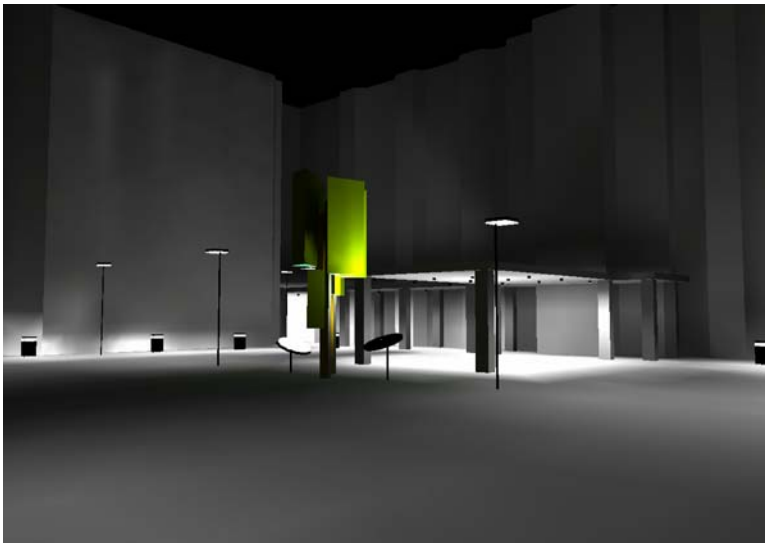


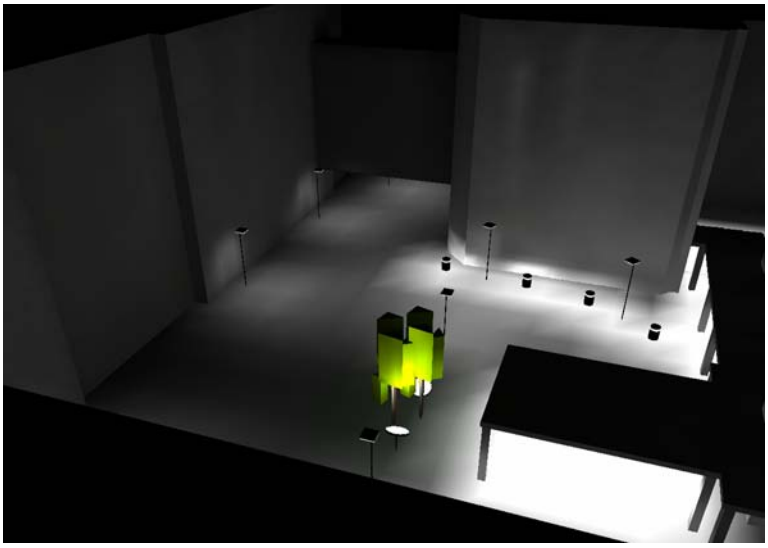


These Pseudo Color images show the various illuminance levels that are achieve with the electric lighting. It was important to have higher illuminance levels on the walkway and at the entry to the building. The Porte Cochere acts as another buffer zone of light to help with adaptation from outdoor illuminance levels to indoor levels. Refer to the Iso-line diagram for approximate foot candle levels in any specific area. The scale was set so that all of the electric lighting would be shown in the pseudo color image. The red area in the birds eye view is has an illuminance level around 20-30 fc, the brick covered walkways have approximately 5-10, and the general roadway has an average of 1-2 fc.

Lighting depth

RENDERINGS





The renderings, although very basic in nature, further illustrate how the selected luminaires perform, and what, if any, light falls on the buildings. As you can see from the renderings, spill light is minimal, and with the pole light fixture that I have specified, there should be no issues with light entering the resident rooms.

Lighting depth

Power Density

Outdoor Space				
Luminaire	#	ballast watts	total watts	
C1	25	48	1200	
C3	8	118	944	
C4	18	62	1116	
C5	2	48	96	
			3356	watt total
			48490	sq footage
			0.06921015	w/sqft

ASHRAE 90.1 – Using the space-by-space method.

ASRAE 90.1 – 9.4.5 **Exterior Building Lighting Power.** The total exterior lighting power allowance for all exterior building applications is the sum of the individual lighting power densities permitted in Table 9.4.5 for these applications plus additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among exterior lighting applications listed in the Table 9.4.5 "Tradable Surfaces" section.

Branch Circuit Connected Load

SPACE	PANEL	V	CKT #	CONNECTED VA	CON'T LOAD(1.25)	Max amps/ckt
Outdoor	L1E2	277	17	1200	1500	<4432
Outdoor	L1E2	277	18	2156	2695	<4433

Light Loss Factors

BUILDING EXTERIOR							
LIGHT LOSS FACTORS							
TYPE	BF	CLEANING INTERVAL	MAINTENANCE CATEGORY	LLD	RSSD	LDD	TOTAL
C1	1	CLEAN (12MONTHS)	V	0.8		0.9	0.72
C3	1	CLEAN (12MONTHS)	V	0.85		0.9	0.765
C4	1	CLEAN (12MONTHS)	III	0.55		0.9	0.495
C5	1	CLEAN (12MONTHS)	V	0.8		0.9	0.72

IESNA:22-25
LDD exposure

IESNA 22-25: Luminaire Surface Depreciation: Experience is the best predictor; no factors are available at present

- therefore, I am going to omit this factor
- reason being: the associated surface dirt would be encountered under the assumed reflectance for the various surfaces...therefore, it's already accounted for

CONCLUSION

After running the various calculations for this area, I found that I met the desired criteria on a numerical basis of providing appropriate illuminance levels and staying within the allotted power density specified by ASHRAE 90.1. As you can see from the images contained with the Outdoor Section of the report, there are different illuminance levels for different areas of the building exterior. You can think of it as three layers of light. The first general layer is provided by the pole mounted fixtures that use (1)50W-MH lamp. This fixture provides the necessary roadway illumination for vehicular movement and walking to and from buildings. The next layer of light is provided by the bollards that are used to illuminate the brick walkways. This fixture use (1) 100W-MH lamp to provide higher illuminance levels on the walkways. There were two reasons for choosing this higher wattage lamp for the bollards. One, I really wanted to increase the light levels on the walkways to accentuate the brick pavers and the neighboring vegetation. The fact that the light source for the bollard is 4' off the ground provides good amounts of spill light to the neighboring vegetation and walkway, but without being a source by which light could infiltrate the residents' rooms. The second reason is given the light loss factors associated with metal halide sources; I wanted to make sure I was maintaining increased illuminance levels after the associated lumen losses went into effect. The next layer of light is provided by the recessed downlights that are in the Porte Cochere and Covered Walkway. These fixtures are outfitted with (1) 39W Metal Halide Lamp that has better efficacy and lamp life than a comparable compact fluorescent source. With this design, I want the outdoor lighting to be on for all hours of the night. A roof-top photo sensor mounted on a 3 foot pole (to keep in view in case of snow fall or debris), will turn the pole mounted fixture and bollards on as night falls. The downlights in the Porte Cochere are controlled by a wall switch, and as I said, I want those fixtures to be on for all hours of the night, so there should not be issue with re-strike time due to switching.

All luminaire cutsheets are provided in Appendix A and referenced by there letter/number designation. Refer to the Lighting Fixture schedule to find lamp specifications and ballast specifications. All lamps will be provided by Sylvania while ballasts are provided by Lutronand Advance Transformer. The lamp and ballast information can be found on the CD provided, of which will include the complete Sylvania lamp catalog for any reference to a specific lamp that may be desired.

This concludes the Lighting Depth Report. The remainder of the report focuses solely on the new addition, of which you can find designs and feasibility studies for the mechanical and electrical equipment. Enjoy!